



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

HIGHLIGHTED ARTICLES

[Hurricane intensification along United States coast suppressed during active hurricane periods](#)

Nature (38.138)

[Marine mammal response operations during the Deepwater Horizon oil spill](#)

Endangered Species Research (1.81)

[Shifting paradigms in restoration of the world's coral reefs](#)

Global Change Biology (8.444)

[Clarifying the role of coastal and marine systems in climate mitigation](#)

Frontiers in Ecology and the Environment (8.504)

[Red snapper distribution on natural habitats and artificial structures in the northern Gulf of Mexico](#)

Marine and Coastal Fisheries (1.442)

[New ocean, new needs: Application of pteropod shell dissolution as a biological indicator for marine resource management](#)

Ecological Indicators (3.190)

[Reconciling ocean productivity and fisheries yields](#)

Proceedings of the National Academy of Sciences (9.423)

[Collapse and recovery of forage fish populations prior to commercial exploitation](#)

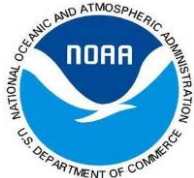
Geophysical Research Letters (4.456)

[Fisheries, food, and health in the United States: The importance of aligning fisheries and health policies](#)

Agriculture & Food Security (1.89)

[Preliminary recovery of coastal sharks in the south-east United States](#)

Fish and Fisheries (8.52)



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

The Impacts of Climate Change on Marine Fisheries and Aquaculture
Book

CROSS LINE OFFICE ARTICLES

Spatiotemporal assessment of CO₂-carbonic acid system dynamics in a pristine coral reef ecosystem

Aquatic Geochemistry (1.458)

Using salinity to identify common Bottlenose Dolphin habitat in Barataria Bay, LA

Endangered Species Research (1.81)

ADDITIONAL ARTICLES

NOS Publications

Satellite retrievals of *Karenia brevis* harmful algal blooms in the West Florida Shelf using neural networks and comparisons with other techniques

Remote Sensing (3.036)

NMFS Publications

Improving catch utilization in the U.S. West Coast groundfish bottom trawl fishery: An evaluation of T90 mesh and diamond mesh codends

Marine and Coastal Fisheries (1.442)

Threshold effects in meta-analyses of benefit transfer for coral reef valuation

Ecological Economics (2.713)

Tiny estimates of the N/N ratio in marine fishes: Are they real?

Journal of Fish Biology (1.658)

Time trends of persistent organic pollutants in benthic and pelagic indicator fishes from Puget Sound, Washington, USA

Archives of Environmental Contamination and Toxicology (2.039)



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

[Accounting for spatial complexities in the calculation of biological reference points: effects of misdiagnosing population structure for stock status indicators](#)

Canadian Journal of Fisheries and Aquatic Sciences (2.437)

[Does the lunar cycle affect reef fish catch rates?](#)

North American Journal of Fisheries Management (1.013)

[Management strategy evaluation using the individual-based, multispecies modeling approach OSMOSE](#)

Ecological Modelling (2.275)

[Evaluating signals of oil spill impacts, climate, and species interactions in Pacific herring and Pacific salmon populations in Prince William Sound and Copper River, Alaska](#)

PLoS ONE (3.057)

[Validation of band counts in eyestalks for the determination of age of Antarctic krill, *Euphausia superba*](#)

PLoS ONE (3.057)

[Guidelines for genetic data analysis](#)

Journal of Cetacean Research and Management (0.80)

[Purging putative siblings from population genetic datasets: A cautionary view](#)

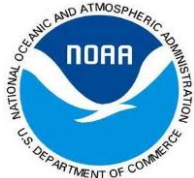
Molecular Ecology (5.947)

[Examining metrics and magnitudes of molecular genetic differentiation used to delimit cetacean subspecies based on mitochondrial DNA control region sequences](#)

Marine Mammal Science (1.665)

[A right whale pootree: Classification trees of fecal hormones identify reproductive states in North Atlantic right whales \(*Eubalaena glacialis*\)](#)

Conservation Physiology (2.98)



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

[Cetacean sightings and acoustic detections during a seismic survey off Nicaragua and Costa Rica, November-December 2004](#)

International Journal of Tropical Biology and Conservation/Revista de Biología Tropical (0.544)

[Species-specific responses of demersal fishes to near-bottom oxygen levels within the California Current large marine ecosystem](#)

Marine Ecology Progress Series (2.361)

[Intraspecific variability in the life history of endemic coral reef fishes between photic and mesophotic depths in the central Pacific Ocean](#)

Coral Reefs (3.000)

[Human-mediated evolution in a threatened species? Juvenile life-history changes in Snake River salmon](#)

Evolutionary Applications (4.572)

[Progress towards a next-generation fisheries ecosystem model for the northern Gulf of Mexico](#)

Ecological Modelling (2.275)

[Risky business for a juvenile marine predator? An indirect test of the influence of foraging strategies and natural selection on size and growth rate in the wild](#)

Proceedings of the Royal Society of London Series B (4.823)

[Combining functional data with hierarchical Gaussian process models](#)

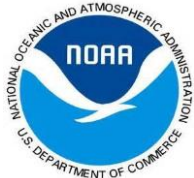
Environmental and Ecological Statistics (0.769)

[Age and growth of juvenile green turtles \(*Chelonia mydas*\) in the western South Atlantic Ocean](#)

Marine Ecology Progress Series (2.361)

[Improving detection of short-duration fishing behaviour in vessel tracks by feature engineering of training data](#)

ICES Journal of Marine Science (2.801)



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

[Population assessment using multivariate time-series analysis: A case study of rockfishes in Puget Sound](#)

Ecology and Evolution (2.537)

[Highly localized replenishment of coral reef fish populations near nursery habitats](#)

Marine Ecology Progress Series (2.361)

[Ocean size and corresponding life history diversity among the four run timings of California Central Valley Chinook salmon](#)

Transactions of the American Fisheries Society (1.469)

[Estimating partial regulation in spatio-temporal models of community dynamics](#)

Ecology (5.175)

[Phylogenetics and biogeography of the two-wing flyingfish \(*Exocoetidae: Exocoetus*\)](#)

Ecology and Evolution (2.537)

[Spawning locations and larval dispersal of Atlantic Menhaden during 1977-2013](#)

ICES Journal of Marine Science (2.626)

[Linear correlations in bamboo coral \$d^{13}C\$ and \$d^{18}O\$ sampled by SIMS and micromill: evaluating paleoceanographic potential and biomineralization mechanisms using \$d^{11}B\$ and \$\Delta_{47}\$ composition](#)

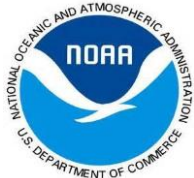
Chemical Geology (3.482)

[Life history of the orange-striped emperor *Lethrinus obsoletus* from the Mariana Islands](#)

Ichthyological Research (1.023)

[A review of molecular genetic markers and analytical approaches that have been used for delimiting marine mammal subspecies and species](#)

Marine Mammal Science (1.665)



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

OAR Publications

[Improving volcanic ash predictions with the HYSPLIT dispersion model by assimilating MODIS satellite retrievals](#)

Atmospheric Chemistry and Physics (5.114)

[Multiple metabolisms constrain the anaerobic nitrite budget in the Eastern Tropical South Pacific](#)

Global Biogeochemical Cycles (4.495)

[Widespread tectonic extension at the Central Indian Ridge between 8°S and 18°S](#)

Gondwana Research (8.743)

[Two decades of Pacific anthropogenic carbon storage and ocean acidification along GO-SHIP Sections P16 and P02](#)

Global Biogeochemical Cycles (4.495)

[Barrier effect of the Indo-Pacific Maritime Continent on the MJO: Perspectives from tracking MJO precipitation](#)

Journal of Climate (4.31)

[A decade of volcanic construction and destruction at the summit of NW-Rota-1 Seamount, 2004–2014](#)

Journal of Geophysical Research (3.44)

[Quantifying the predatory effect of round goby on Saginaw Bay dreissenids](#)

Journal of Great Lakes Research (1.910)

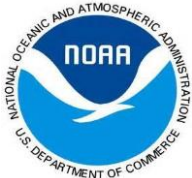
[Moving from ecosystem-based policy objectives to operational implementation of ecosystem-based management measures](#)

ICES Journal of Marine Science (2.626)

NESDIS Publications

[Validation of the effect of cross-calibrated GOES solar proton effective energies on derived integral fluxes by comparison with STEREO observations](#)

Space Weather (2.846)



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

NWS Publications

[On the impact and future benefits of AMDAR observations in operational forecasting - Part 2: Water vapor observations](#)

Bulletin of the American Meteorological Society (7.929)

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

NOS Publications

[An Economic Analysis of Shipping Costs and Pollution Emissions Related to Potential Measures to Manage the Co-Occurrence of Maritime Vessel Traffic and Whales in the Channel Islands Region](#)

NCCOS Technical Memorandum

NMFS Publications

[Animal Movement: Statistical Models for Telemetry Data](#)

Book

[The use of satellite tags to inform the stock assessment of a data poor species: Estimating vertical availability of spiny dogfish in the Gulf of Alaska](#)

Assessing and Managing Data-Limited Fish Stocks, Alaska Sea Grant

HIGHLIGHTED ARTICLES

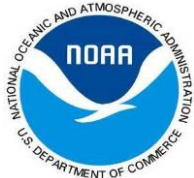
Hurricane intensification along United States coast suppressed during active hurricane periods

Nature (38.138)

J. P. Kossin (NESDIS/NCEI)

- Variability in sea surface temperature by region along the United States coast may help to explain hurricane frequency and variability.
- Heightened variability in hurricane intensity poses challenges to operational forecasting and greater risk to coastal regions during hurricane events.

The North Atlantic ocean/atmosphere environment exhibits pronounced interdecadal variability that is known to strongly modulate Atlantic hurricane activity. Variability in sea surface temperature (SST) is correlated with hurricane variability through its relationship with the genesis and thermodynamic potential intensity of hurricanes. Another key factor that governs the genesis and intensity of hurricanes is ambient environmental vertical wind shear (VWS). Warmer SSTs generally correlate with more frequent genesis and greater potential intensity,



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

while VWS inhibits genesis and prevents any hurricanes that do form from reaching their potential intensity. When averaged over the main hurricane-development region in the Atlantic, SST and VWS co-vary inversely, so that the two factors act in concert to either enhance or inhibit basin-wide hurricane activity. Here I show, however, that conditions conducive to greater basin-wide Atlantic hurricane activity occur together with conditions for more probable weakening of hurricanes near the United States coast. Thus, the VWS and SST form a protective barrier along the United States coast during periods of heightened basin-wide hurricane activity. Conversely, during the most-recent period of basin-wide quiescence, hurricanes (and particularly major hurricanes) near the United States coast, although substantially less frequent, exhibited much greater variability in their rate of intensification, and were much more likely to intensify rapidly. Such heightened variability poses greater challenges to operational forecasting and, consequently, greater coastal risk during hurricane events.

Publication date: January 19, 2017

Available online:

<http://www.nature.com/nature/journal/v541/n7637/pdf/nature20783.pdf>

Marine mammal response operations during the Deepwater Horizon oil spill
Endangered Species Research (1.81)

S. M. Wilkin (NMFS/OPR), T. K. Rowles (NMFS/OPR), E. Stratton (NMFS/SEFSC), N. Adimey, C. L. Field, S. Wissmann (NMFS/OPR), G. Shigenaka (NOS/ORR), E. Fougères (NMFS/SERO), B. Mase (NMFS/SEFSC), and M. H. Ziccardi

- This article is a review of actions conducted under Incident Command response for marine mammals following the Deepwater Horizon oil spill.
- The authors provide lessons learned for future responders regarding marine mammal habitat and highlight the first rehabilitation of oiled dolphin following the disaster.

When the *Deepwater Horizon* (DWH) oil spill occurred in April 2010 in the Gulf of Mexico, wildlife professionals were quickly mobilized to assess, recover, and treat oiled marine mammals as part of the Incident Response operating under the Unified Command. There were significant challenges associated with the crisis, including the sustained response to a prolonged, uncontrolled oil release (from a deepwater wellhead rather than a controllable and finite source like a tanker); the large geographic scale of the oiled area and thus the response effort; and ensuring effectiveness without the benefit of previous experience of cetacean response in oil



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

spills. The response phase for this spill lasted from April 2010 to May 2011, and the mobilization of field teams resulted in the confirmation of 13 live and 178 dead stranded cetaceans across 4 states and offshore waters. Four primary care centers were coordinated to de-oil animals, and additional facilities and personnel were mobilized to augment and support the effort. Numerous protocols were implemented to ensure appropriate animal care as well as documentation and sample collection, informing both response and Natural Resource Damage Assessment decisions. Additional efforts included the implementation of a wildlife observer program integrated into oil recovery operations (skimming and *in situ* burns) and behavioral observations of nearshore cetaceans. The unprecedented effort resulted in the first rehabilitation of an oiled dolphin and the coordination of a very large-scale response, with important information collected, and lessons learned for future oil spills in marine mammal habitat.

Publication date: January 31, 2017

Available online: <http://www.int-res.com/articles/esr2017/33/n033p107.pdf>

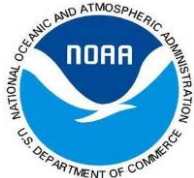
Shifting paradigms in restoration of the world's coral reefs

Global Change Biology (8.444)

M. J. H. Van Oppen, R. D. Gate, L. L. Blackall, N. Cantin, L. J. Chakravarti, W. Y. Chan, C. Cormick, A. Crean, K. Damjanovic, H. Epstein, P. L. Harrison, T. A. Jones, **M. Miller (NMFS/SEFSC)**, R. J. Pears, L. M. Peplow, D. A. Raftos, B. Schaffelke, K. Stewart, G. Torda, D. Wachenfeld, A. R. Weeks, H. M. Putnam

- The paper articulates the inadequacy of current coral conservation/restoration strategies under the current regime of rapid environmental change (as demonstrated by the dire effects of the recent 2015-16 global coral bleaching event).
- Suggests the consideration and development of more interventionist strategies such as selective breeding, manipulation of symbiotic partnerships and assisted gene flow, and proposes a management 'decision tree' to guide the appropriate application of such tools.

Many ecosystems around the world are rapidly deteriorating due to both local and global pressures, and perhaps none so precipitously as coral reefs. Management of coral reefs through maintenance (e.g., marine protected areas, catchment management to improve water quality), restoration, as well as global and national governmental agreements to reduce greenhouse gas emissions (e.g., the 2015 Paris Agreement) are critical for the persistence of coral reefs. Despite these initiatives, the health and abundance of corals reefs are rapidly declining and other solutions



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

will soon be required. We have recently discussed options for using assisted evolution (i.e., selective breeding, assisted gene flow, conditioning or epigenetic programming, and the manipulation of the coral microbiome) as a means to enhance environmental stress tolerance of corals and the success of coral reef restoration efforts. The 2015-2016 global coral bleaching event has sharpened the focus on such interventionist approaches. We highlight the necessity for consideration of alternative (e.g., hybrid) ecosystem states, discuss traits of resilient corals and coral reef ecosystems, and propose a decision tree for incorporating assisted evolution into restoration initiatives in order to enhance climate resilience of coral reefs.

Publication date: February 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1111/gcb.13647/epdf>

Clarifying the role of coastal and marine systems in climate mitigation

Frontiers in Ecology and the Environment (8.504)

J. Howard, **A. Sutton-Grier (NOS/ASTADM)**, D. Herr, J. Kleypas, E. Landis, E. Mcleod, E. Pidgeon, and S. Simpson

- Coastal wetlands sequester substantial amounts of carbon, mostly in soils.
- Coral reefs, kelp, and marine fauna, while important components of carbon cycling in the ocean, are not involved in long-term carbon sequestration.
- Due to jurisdictional issues, practical management of coral, phytoplankton, kelp, and marine fauna within climate mitigation frameworks would be difficult.
- Current climate mitigation efforts in the coastal and marine realm should focus primarily on coastal wetlands, as they represent long-term carbon sinks and potential carbon sources upon conversion, and can be managed for their carbon sequestration value.

The international scientific community is increasingly recognizing the role of natural systems in climate-change mitigation. While forests have historically been the primary focus of such efforts, coastal wetlands –particularly seagrasses, tidal marshes, and mangroves – are now considered important and effective long-term carbon sinks. However, some members of the coastal and marine policy and management community have been interested in expanding climate mitigation strategies to include other components within coastal and marine systems, such as coral reefs, phytoplankton, kelp forests, and marine fauna. We analyze the scientific evidence regarding whether these marine ecosystems and ecosystem components are viable long-term carbon sinks and whether they can be managed



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

for climate mitigation. Our findings could assist decision makers and conservation practitioners in identifying which components of coastal and marine ecosystems should be prioritized in current climate mitigation strategies and policies.

Publication date: February 1, 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/fee.1451/epdf>

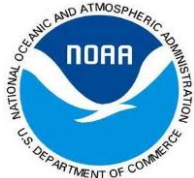
Red snapper distribution on natural habitats and artificial structures in the northern Gulf of Mexico

Marine and Coastal Fisheries (1.442)

M. Karnauskas, J. F. Walter III, M. D. Campbell, A. G. Pollack
(NMFS/SEFSC), J. M. Drymon, and S. Powers

- The authors find that artificial structures harbor substantial numbers of young age classes of Red Snapper, particularly in areas with high densities of artificial structures and little natural reef habitat. In these areas, such structures harbor the majority of 1-2 year-old fish. However artificial structures make up only a small proportion of the total habitat available.
- While the contribution of artificial structures is relatively large for young fish, the importance of artificial structure decreases with older age classes. Therefore, in terms of biomass and fecundity, the influence of artificial structures is minimal – they harbor just over 6% of the total Red Snapper spawning potential for the Gulf of Mexico population.
- This paper gives an estimate of the numbers, biomass, and spawning potential of red snapper on artificial structures, and finds that the contribution is relatively minor. It thereby helps to address the criticism that the stock assessment process does not properly account for the abundance of red snapper on artificial habitat.

In 2011, an intensive, multiple-gear, fishery-independent survey was carried out in the northern Gulf of Mexico (GOM) to collect comprehensive age and length information on Red Snapper *Lutjanus campechanus*. Based on this synoptic survey, we produced a spatial map of Red Snapper relative abundance that integrates both gear selectivity effects and ontogenetically varying habitat usage. Our methodology generated a spatial map of Red Snapper at a 10-km² grid resolution that is consistent with existing knowledge of the species: Red Snapper occurred in relatively high abundances at depths of 50–90 m along the coasts of Texas and Louisiana and in smaller, patchy “hot spots” at a variety of depths along the Alabama coast and the west Florida shelf. Red Snapper biomass and fecundity estimates were higher for the northwestern GOM than for the northeastern GOM,



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

as the latter area contained mostly smaller, younger individuals. The existence of similar surveys on petroleum platforms and artificial reefs also enabled us to calculate their relative contribution to Red Snapper distribution compared with that of natural habitats. We estimated that for the youngest age-classes, catch rates were approximately 20 times higher on artificial structures than on natural reefs. Despite the high catch rates observed on artificial structures, they represent only a small fraction of the total area in the northern GOM; thus, we estimated that they held less than 14% of Red Snapper abundance. Because artificial structures - particularly petroleum platforms - attract mostly the youngest individuals, their contribution was even lower in terms of total population biomass (7.8%) or spawning potential (6.4%). Our estimates of Red Snapper relative abundance, biomass, and spawning potential can be used to design spatial management strategies or as inputs to spatial modeling techniques.

Publication date: February 15, 2017

Available online:

<http://www.tandfonline.com/doi/full/10.1080/19425120.2016.1255684>

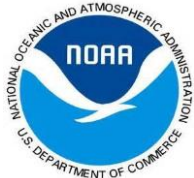
New ocean, new needs: Application of pteropod shell dissolution as a biological indicator for marine resource management

Ecological Indicators (3.190)

N. Bednaršek, T. Klinger, **C. J. Harvey (NMFS/NWFSC)**, S. Weisberg, R. M. McCabe, **R. A. Feely (OAR/PMEL)**, J. Newton, and N. Tolimieri

- Euthecosome pteropods like *L. helicina* are excellent candidate species for ocean acidification indicators, due to their response sensitivity and specificity.
- Pteropod shell dissolution is strongly related to other, harder-to-measure metrics of pteropod condition, like calcification and survival.
- Adopting pteropod shell dissolution metrics for bio-assessments of ocean acidification can help meet the needs of regulators and resource managers concerned with water quality assessment and ecosystem based management.

Pteropods, planktonic marine snails with a cosmopolitan distribution, are highly sensitive to changing ocean chemistry. Graphical abstract shows pteropod responses to be related to aragonite saturation state, with progressing decrease in Ω_{ar} causing deteriorating biological conditions. Under high saturation state ($\Omega_{ar} > 1.1$; zone 0), pteropods are healthy with no presence of stress or shell dissolution. With decreasing Ω_{ar} (zone 1), pteropod stress is demonstrated through increased dissolution and reduced calcification. At $\Omega_{ar} < 0.8$ (zones 2 and 3), severe



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

dissolution and absence of calcification prevail; the impairment is followed by significant damages. Pteropods responses to OA are closely correlated to shell dissolution that is characterized by clearly delineated thresholds. Yet the practical utility of these species as indicators of the status of marine ecosystem integrity has been overlooked. Here, we set out the scientific and policy rationales for the use of pteropods as a biological indicator appropriate for low-cost assessment of the effect of anthropogenic ocean acidification (OA) on marine ecosystems. While no single species or group of species can adequately capture all aspects of ecosystem change, pteropods are sensitive, specific, quantifiable indicators of OA's effects on marine biota. In an indicator screening methodology, shell dissolution scored highly compared to other indicators of marine ecological integrity. As the socio-economic challenges of changing ocean chemistry continue to grow in coming decades, the availability of such straightforward and sensitive metrics of impact will become indispensable. Pteropods can be a valuable addition to suites of indicators intended to support OA water quality assessment, ecosystem-based management, policy development, and regulatory applications.

Publication date: February 3, 2017

Available Online:

<http://www.sciencedirect.com/science/article/pii/S1470160X17300316>

Reconciling ocean productivity and fisheries yields

Proceedings of the National Academy of Sciences (9.423)

C. A. Stock (OAR/GFDL), J. G. John (OAR/GFDL), R. R. Rykaczewski, R. G. Asch, W. W. L. Cheung, J. P. Dunne (OAR/GFDL), K. D. Friedland (NMFS/NEFSC), V. W. Y. Lam, J. L. Sarmiento, and R. A. Watson

- The relationship between phytoplankton productivity and fisheries catch is complicated by uncertainty in catch estimates, fishing effort, and marine food web dynamics.
- Global data sources and high resolution earth system model was used to address uncertainties in fisheries catch.
- Results show that cross-ecosystem fisheries catch differences far exceeding differences in phytoplankton production can be reconciled with fishing effort and variations in marine food web structure and energy transfer efficiency.

Photosynthesis fuels marine food webs, yet differences in fish catch across globally distributed marine ecosystems far exceed differences in net primary production (NPP). We consider the hypothesis that ecosystem-level variations in pelagic and benthic energy flows from phytoplankton to fish, trophic transfer



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

efficiencies, and fishing effort can quantitatively reconcile this contrast in an energetically consistent manner. To test this hypothesis, we enlist global fish catch data that include previously neglected contributions from small-scale fisheries, a synthesis of global fishing effort, and plankton food web energy flux estimates from a prototype high-resolution global earth system model (ESM). After removing a small number of lightly fished ecosystems, stark interregional differences in fish catch per unit area can be explained ($r = 0.79$) with an energy-based model that (i) considers dynamic interregional differences in benthic and pelagic energy pathways connecting phytoplankton and fish, (ii) depresses trophic transfer efficiencies in the tropics and, less critically, (iii) associates elevated trophic transfer efficiencies with benthic-predominant systems. Model catch estimates are generally within a factor of 2 of values spanning two orders of magnitude. Climate change projections show that the same macroecological patterns explaining dramatic regional catch differences in the contemporary ocean amplify catch trends, producing changes that may exceed 50% in some regions by the end of the 21st century under high-emissions scenarios. Models failing to resolve these trophodynamic patterns may significantly underestimate regional fisheries catch trends and hinder adaptation to climate change.

Publication date: January 23, 2017

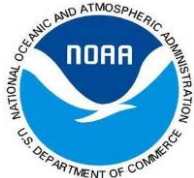
Available online: <http://www.pnas.org/content/114/8/E1441.full>

Collapse and recovery of forage fish populations prior to commercial exploitation
Geophysical Research Letters (4.456)

S. McClatchie, I. L. Hendy, A. R. Thompson, and W. Watson (NMFS/SWFSC)

- The paleorecord shows that “collapse” (defined as $<10\%$ of the mean peak biomass) is a normal state repeatedly experienced by northern anchovy, Pacific hake, and Pacific sardine fisheries.
- Mean return times to the same biomass was 8 years for anchovy, but 22 years for sardine and hake.
- Sardine and anchovy are positively correlated on the 500-year time scale, consistent with coherent declines of both species off California.

We use a new, well-calibrated 500-year paleorecord off southern California to determine collapse frequency, cross-correlation, persistence and return times of exploited forage fish populations. The paleorecord shows that “collapse” (defined as $<10\%$ of the mean peak biomass) is a normal state repeatedly experienced by northern anchovy, Pacific hake and Pacific sardine which were collapsed 29-40% of the time, prior to commercial fishing exploitation. Mean (\pm SD) persistence of



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

“fishable biomass” (defined as 1/3 mean peak biomass from the paleorecord) was 19 +/- 18, 15 +/- 17, and 12 +/- 7 years for anchovy, hake, and sardine. Mean return times to the same biomass was 8 years for anchovy, but 22 years for sardine and hake. Further, we find that sardine and anchovy are positively correlated on the 500-year time scale, consistent with coherent declines of both species off California. Persistence and return times, combined with positive sardine-anchovy correlation indicates that on average 1-2 decades of fishable biomass will be followed by 1-2 decades of low forage. Forage populations are resilient on the 500-year time scale, but their collapse and recovery cycle is suited to alternating periods of high fishing mortality and periods of little or no fishing.

Publication date: February 22, 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/2016GL071751/full>

Fisheries, food, and health in the United States: The importance of aligning fisheries and health policies

Agriculture & Food Security (1.89)

D. Love, **P. Pinto da Silva**, J. Olson; J. P. Fry, **P. M. Clay** (NMFS/NEFSC)

- The authors describe a method for linking seafood policies across multiple federal agencies to address issues of food security.
- Social, political, biophysical, and economic aspects of seafood are connected within the broader food system.

Background: Food availability, access, and utilization are the three pillars of food security, and need to be aligned in order to support a healthy population. U. S. fisheries policy plays an important role in seafood availability. U.S. health policy impacts access and use of seafood in various ways; however, health policies are often disconnected from fisheries policy. Aligning fisheries and health policies is imperative to improve food security.

Methods: We use primary and secondary literature and communication among experts/stakeholders to explore how fisheries policies and health policies are additive, synergistic, or antagonistic with regards to seafood.

Results: We address two questions with our work: i) how would U.S. fisheries policy be different if our fisheries were managed with beneficial health outcomes for Americans as clear objectives; and ii) how would U.S. health policy be different if one of its goals were to support sustainable domestic fisheries and aquaculture? We provide illustrative examples of collaboration between health and fisheries communities at different levels of the food system (federal and state policies, corporate partnerships, and civil society). We also developed a list of



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

topics for future research, and opportunities to align and integrate fisheries and health policies.

Conclusions: Managing fisheries to promote optimal nutrition and efficient food production likely requires a different approach to fisheries management- new outcomes will need to be monitored, new approaches found and fisheries, aquaculture, and health policies better integrated. Health policies rarely consider the source of fish, their connections with U.S. fisheries systems, and global distribution of seafood. Change can begin where the most promising opportunities exist, such as in institutional food procurement, farm to school programs, social marketing campaigns, and private sector start-ups. Continued development in fisheries and health policies, however, will need to occur at multiple levels of federal policy, and across the different domains and dimensions of the food system (e.g. social, political, biophysical, economic).

Acceptance date: January 16, 2017

Preliminary recovery of coastal sharks in the south-east United States

Fish and Fisheries (8.52)

C. D. Peterson, C. N. Belcher, **D. M. Bethea (NMFS/SERO)**, **W. B Driggers III (NMFS/SEFSC)**, B. S. Frazier, and R. J. Latour

- Catch per unit effort of coastal sharks was variable across space, season and depth, even within the relatively small areas covered by the surveys.
- The patterns of relative abundance of large coastal shark stocks provide a more optimistic outlook and more closely align with results presented by Carlson, Hale, Morgan, and Burgess (2012), where spinner shark and tiger shark, among other species, were shown to have increased in abundance by 14% and 3%, respectively, following enactment of the shark fishery management plan.
- With the exception of the Gulf of Mexico blacknose shark, relative population declines for small coastal shark stocks were minimal and followed by substantial increases that were much smaller in magnitude than those predicted by Myers *et al.* (2007).
- When immediate environmental conditions are unfavorable, the coastal shark species examined may redistribute to more suitable conditions which can impact recruitment and migration.

Relative abundance of many shark species in the Atlantic is assessed by compiling data from several independently conducted, but somewhat spatially limited surveys. Although these localized surveys annually sample the same populations,



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

resulting trends in yearly indices often conflict with one another, thereby hindering interpretation of abundance patterns at broad spatial scales. We used delta-lognormal generalized linear models (GLMs) to generate indices of abundance for seven Atlantic coastal shark species from six fishery-independent surveys along the US east coast and Gulf of Mexico from 1975 to 2014. These indices were further analyzed using dynamic factor analysis (DFA) to produce simplified, broad-scale common trends in relative abundance over the entire sampled distribution. Effects of drivers including the North Atlantic Oscillation index, the Atlantic Multidecadal Oscillation index, annually averaged sea surface temperature and species landings were evaluated within the DFA model. The two decadal oscillations and species landings were shown to affect shark distribution along south-east US coast. Estimated common trends of relative abundance for all large coastal shark species showed similar decreasing patterns into the early 1990s, periods of sustained low index values thereafter and recent indications of recovery. Small coastal shark species exhibited more regional variability in their estimated common trends, such that two common trends were required to adequately describe patterns in relative abundance throughout the Gulf of Mexico and Atlantic. Overall, all species' (except the Gulf of Mexico blacknose shark) time series concluded with an increasing trend, suggestive of initial recovery from past exploitation.

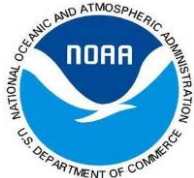
Publication date: February 10, 2017

Available Online: <http://onlinelibrary.wiley.com/doi/10.1111/faf.12210/full>

The Impacts of Climate Change on Marine Fisheries and Aquaculture

Edited: B. Phillips and M. Perez-Ramirez

Contributing authors: Introduction: **J. Peterson (NMFS/OST) and R. Griffis (NMFS/OST)**; Gulf of Alaska: **S. G. Zador (NMFS/AKFSC), M. F. Sigler (NMFS/AKFSC) and J. E. Joyce (NMFS/AKFSC)**; California Current: **S. Bograd (NMFS/SWFSC), M. Hunsicker (NMFS/NWFSC), S. McClatchie (NMFS/SWFSC), J. Morris, Jr. (NOS/NCCOS), and W. T. Peterson (NMFS/NWFSC)**; Pacific Islands: **P. A. Woodworth-Jefcoats (NMFS/PIFSC)**; Gulf of Mexico: **M. Karnauskas (NMFS/SEFSC), R. Muñoz (NMFS/SEFSC), A. Schueller (NMFS/SEFSC) and J. K. Craig (NMFS/SEFSC)**; Southeast US Atlantic: **T. Kellison (NMFS/SEFSC), R. Muñoz (NMFS/SEFSC), N. Bacheler (NMFS/SEFSC), K. Gore (NMFS/SER), and J. Morris, Jr. (NOS/NCCOS)**; Northeast US Atlantic: **J. A. Hare (NMFS/NEFSC), K. D. Friedland (NMFS/NEFSC) and T. J. Miller (NMFS/NEFSC)**



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

Important conclusions for the California Current, most are applicable to other regions:

- Climate change can impact fisheries and aquaculture in this system through multiple physical and biological processes, including changes in the timing and intensity of coastal upwelling, changes in vertical stratification, surface temperatures and sea level rise, and declines in nutrients, dissolved oxygen content and pH in shelf waters.
- Changes in coastal upwelling can alter its timing and that of plankton blooms which can decouple phenological relationships between predators and prey.
- Enhanced stratification and reduced ventilation limits the delivery of nutrient and oxygen-rich waters to the upper ocean. Reduced food availability and severe hypoxia affect the viable habitat, distribution, abundance, and survival of marine fauna.
- The expected sea level rise along the U.S. west coast will alter space available for aquaculture. Future climate-driven changes in water temperatures, storm surge, drought and flooding events can alter water conditions and potentially compromise the growth and well-being of farmed shellfish and salmon.
- The California Current System (CCS) is highly vulnerable to ecological impacts of ocean acidification due to the combination of a reduction in aragonite saturation state and increasing “corrosive”, lower pH upwelled waters.
- An understanding of the synergistic effects of the multiple climate and human pressures on ecosystem components is needed to develop more accurate scenarios of climate change impacts on the CCS. Consistent time series of physical and biological data throughout the CCS are invaluable for resolving these effects.

Accepted Date: January 2017

Available Online: <http://www.wiley.com/WileyCDA/WileyTitle/productCd-1119154049.html>



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

CROSS LINE OFFICE ARTICLES

Spatiotemporal assessment of CO₂-carbonic acid system dynamics in a pristine coral reef ecosystem

Aquatic Geochemistry (1.458)

A. K. Kealoha, F. T. Mackenzie, S. E. Kahng, **R. K. Kosaki (NOS/ONMS)**, **S. R. Alin (OAR/PMEL)**, and C. D. Winn

- The use of an underway system with continuous sampling for $f\text{CO}_2$ coupled with the highly precise Honeywell DuraFET electrode provides data useful for observing CO₂-carbonic acid system dynamics of coral reef ecosystems over large spatial scales.
- Reef metabolism on the surface seawater inorganic carbon system can either elevate or depress alkalinity values over large areas of the ocean adjacent to coral reefs and probably other carbonate systems.

Observations of surface seawater fugacity of carbon dioxide ($f\text{CO}_2$) and pH were collected over a period of several days at French Frigate Shoals (FFS) in the Northwestern Hawaiian Islands (NWHI) in order to gain an understanding of the natural spatiotemporal variability of the marine inorganic carbon system in a pristine coral reef ecosystem. These data show clear island-to-open ocean gradients in $f\text{CO}_2$ and total alkalinity that can be measured 10–20 km offshore, indicating that metabolic processes influence the CO₂-carbonic acid system over large areas of ocean surrounding FFS and by implication the islands and atolls of the NWHI. The magnitude and extent of this spatial gradient may be driven by a combination of physical and biogeochemical processes including reef water residence time, hydrodynamic forcing of currents and tidal flow, and metabolic processes that occur both on the reef and within the lagoon.

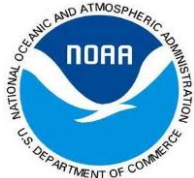
Publication date: January 27, 2017

Available online: <https://link.springer.com/article/10.1007%2Fs10498-017-9310-1>

Using salinity to identify common Bottlenose Dolphin habitat in Barataria Bay, LA Endangered Species Research (1.81)

F. E. Hornsby, T. L. McDonald, **B. C. Balmer (NOS/NCCOS)**, **T. R. Speakman (NOS/NCCOS)**, **K. D. Mullin (NMFS/SEFSC)**, **P. E. Rosel (NMFS/SEFSC)**, R. S. Wells, A. C. Telander, P. W. Marcy, **L. H. Schwacke (NOS/NCCOS)**, K. C. Klaphake

- Potential dolphin habitat was identified in Barataria Bay, LA based on salinity contours as waters with salinity greater than 8 parts per thousand.
- This paper shows that dolphins clearly avoid low salinity waters.



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

- The analysis provides a means to extrapolate an abundance estimate made in a portion of the bay to the entire bay to provide an abundance estimate for the whole stock.

Following the Deepwater Horizon oil spill, numerous studies took place to determine impacts to common bottlenose dolphins (*Tursiops truncatus*). Common bottlenose dolphins are found in estuarine environments of the northern Gulf of Mexico which vary in salinity depending on location (distance to freshwater source), season, and ocean tides. Although common bottlenose dolphins can be found in low salinity waters (e.g., less than 10-15 parts per thousand), they cannot tolerate very low salinity for long periods of time. We matched dolphin telemetry data in Barataria Bay with contemporaneous estimates of salinity to establish a salinity threshold and identify preferred dolphin habitat. Dolphins frequently used areas where salinity was higher than ~11 ppt, sometimes used areas for short periods of time with predicted salinity ~8 ppt, and avoided waters with salinities below ~5 ppt. While not a hard boundary, the ~8 ppt threshold can be used to delineate reasonable polygons of preferred dolphin habitat. We temporally average the location of the ~8 ppt isohaline from 2005 through 2012 to establish areas of preferred dolphin habitat. In Barataria Bay, the polygon of dolphin habitat encompasses 1,167 square kilometers, and extends from the bay's barrier islands to approximately half-way through marshes in northern parts of the bay.

Publication date: January 31, 2017

Available online: <http://www.int-res.com/articles/esr2017/33/n033p181.pdf>

ADDITIONAL ARTICLES

NOS Publications

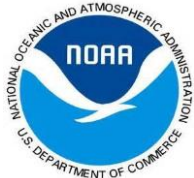
*Satellite retrievals of *Karenia brevis* harmful algal blooms in the West Florida Shelf using neural networks and comparisons with other techniques*

Remote Sensing (3.036)

A. El-habashi, I. Ioannou, **M. C. Tomlinson**, **R. P. Stumpf** (NOS/NCCOS), and S. Ahmed

- This paper provides improved detection and tracking of *Karenia brevis* Harmful Algal Blooms by combining cell counts with satellite data to improve the operational HAB forecast system for West Florida.
- The technique improved when satellite data and in water samples were taken within 1 and 0.5 hrs of each other.

We describe the application of a Neural Network (NN) previously developed by us, for the detection and tracking of *Karenia brevis* Harmful Algal Blooms (KB



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

HABs) that plague the coasts of the West Florida Shelf (WFS) using Visible Infrared Imaging Radiometer Suite (VIIRS) satellite observations. Previous approaches for the detection of KB HABs in the WFS primarily used observations from the Moderate Resolution Imaging Spectroradiometer Aqua (MODIS-A) satellite. They depended on the remote sensing reflectance signal at the 678 nm chlorophyll fluorescence band (Rrs678) needed for both the normalized fluorescence height (nFLH) and Red Band Difference algorithms (RBD) currently used. VIIRS which has replaced MODIS-A, unfortunately does not have a 678 nm fluorescence channel so we customized the NN approach to retrieve phytoplankton absorption at 443 nm (aph443) using only Rrs measurements from existing VIIRS channels at 486, 551 and 671 nm. The aph443 values in these retrieved VIIRS images, can in turn be correlated to chlorophyll-a concentrations [Chla] and KB cell counts. To retrieve KB values, the VIIRS NN retrieved aph443 images are filtered by applying limiting constraints, defined by (i) low backscatter at Rrs 551 nm and (ii) a minimum aph443 value known to be associated with KB HABs in the WFS.

Publication date: May 4, 2016

Available online: <http://www.mdpi.com/2072-4292/8/5/377>

NMFS Publications

Improving catch utilization in the U.S. West Coast groundfish bottom trawl fishery: An evaluation of T90 mesh and diamond mesh codends

Marine and Coastal Fisheries (1.442)

M. J. M. Lomeli, **O. S. Hamel**, **W. W. Wakefield** (NMFS/NWFSC), and D. L. Erickson

- This study shows trade-offs in catch of targeted species and sizes vs. catch and often discard of unmarketable sizes and species using alternative net configurations.
- Improving gear selectivity will improve the economic efficiency of the West Coast groundfish fishery which operates under a catch share program.

The U.S. West Coast limited entry groundfish bottom trawl fishery operates under a catch share program, implemented with the intention of improving the economic efficiency of the fishery, maximizing fishing opportunities, and minimizing bycatch. However, stocks with low harvest guidelines have limited fishermen's ability to maximize catch of more abundant stocks. Size-selection characteristics of 114 mm and 140 mm T90 mesh, and traditional 114 mm diamond mesh codends were examined using the covered codend method. Selection curves and mean *L*50



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

values for two flatfish species (rex sole, *Glyptocephalus zachirus*, and Dover sole, *Microstomus pacificus*), and two roundfish species (shortspine thornyhead, *Sebastolobus alascanus*, and sablefish, *Anoplopoma fimbria*) were estimated. Mean *L50* values were smaller for flatfishes, but larger for roundfishes in the 114 mm T90 codend compared to the diamond codend. The 140 mm T90 codend showed significantly different selectivities from the other codends for rex sole, Dover sole, and shortspine thornyhead, being most effective at reducing the catch of smaller-sized fishes, however with a considerable loss of larger-sized marketable fishes. Findings suggest T90 codends have potential to improve catch utilization in this multispecies fishery.

Acceptance date: December 14, 2016

Threshold effects in meta-analyses of benefit transfer for coral reef valuation
Ecological Economics (2.713)

L. Fitzpatrick, C. Parmeter, and **J. Agar** (NMFS/SEFSC)

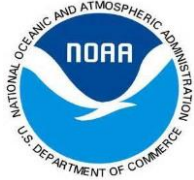
- The statistical method used helped improve the reliability of ‘benefit transfer’ estimates of coral reef amenities (e.g., recreational diving) by explicitly accounting for changes in the amount of live coral cover.

Policymakers and advocates often use benefit transfers to estimate the economic value of environmental amenities when primary valuation studies are infeasible. Benefit transfers based on meta-analyses, which synthesize site and methodological characteristics from valuation studies of similar underlying amenities, generally outperform traditional site-to-site transfers. We build on earlier meta-analyses of willingness-to-pay for tropical coral reef recreation by introducing a meta-regression model with threshold effects, with a goal of increasing transfer reliability. We estimate a threshold in coral reef quality and find that increases in live coral cover have a large impact on individuals' WTP for recreation at degraded coral reefs. Relaxing the assumption of users' constant valuation across the distribution of this characteristic improves the performance of coral reef benefit transfers in some instances: tests of convergent validity reveal that including the threshold effect reduces the mean transfer error and the interquartile range of transfer errors in 5 out of 8 tests.

Publication date: March, 2017

Available online:

<http://www.sciencedirect.com/science/article/pii/S092180091630235X>



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

Tiny estimates of the N_e/N ratio in marine fishes: Are they real?

Journal of Fish Biology (1.658)

R. S. Waples (NMFS/NWFSC)

- If the ratio of effective population size (N_e) to census size (N) is "tiny" ($<10^{-3}$), as some have proposed, even large marine populations could be at genetic risk.
- Tiny N_e/N ratios can occur in species with overlapping generations.
- Genetic methods for estimating N_e can produce "false alarms" of tiny N_e/N ratios if the true N_e is very large.

Theory and empirical estimates agree that the ratio of effective size (N_e) to census size (N) falls roughly in the range 0.1-0.5 for most populations. In a number of marine species, however, genetic estimates of contemporary N_e/N are as much as 5-6 orders of magnitude lower. Although some mechanisms that could produce such tiny N_e/N ratios have been proposed, the subject remains controversial. This issue is important to resolve: if N_e/N can be 10^{-3} or smaller, marine fish populations that are quite large could be at genetic risk. Based on a recently-improved understanding of factors that influence N_e and N_e/N in species with overlapping generations, this paper evaluates conditions necessary to produce tiny N_e/N ratios in actual populations. These analyses show that although increased longevity, fecundity and variance in reproductive success that increase with age, and increased egg quality with age [the big old fat fecund female fish (BOFFFF) hypothesis] all reduce N_e/N , extreme scenarios are required to reduce N_e/N below about 0.01. Therefore, tiny N_e/N ratios require some version of Hedgecock's 'sweepstakes' hypothesis, whereby only a few families reproduce successfully. Simulations using common genetically-based estimators show that, when true N_e is very large ($\geq 10^6$), a substantial fraction of point estimates of N_e/N can be 10^{-3} or smaller. These results mean that tiny, genetically-based point estimates of N_e/N in large marine populations are expected to be quite common, even when the true N_e/N ratio is 'normal' (~ 0.1 or higher). Very large samples of individuals can reduce, but not eliminate, this problem. The simulation results also emphasize the importance of considering deviations from model assumptions (e.g. non-random sampling; weak selection or migration) that may be relatively small (and hence can generally be ignored when the signal is strong) but can lead to substantial biases when the drift signal is weak, as is likely for large marine populations. Empirical studies of this topic need to be able to distinguish between episodes of sweepstakes reproductive success that are ephemeral and lead to chaotic genetic patchiness, and those that are consistent enough across space and time to produce persistent evolutionary



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

consequences.

Publication date: October 7, 2016

Available online:

<http://onlinelibrary.wiley.com/doi/10.1111/jfb.13143/abstract;jsessionid=21AFDF567F44FB3C516195286F91EB27.f03t04>

Time trends of persistent organic pollutants in benthic and pelagic indicator fishes from Puget Sound, Washington, USA

Archives of Environmental Contamination and Toxicology (2.039)

J. E. West, S. M. O'Neill, and **G. M. Ylitalo (NMFS/NWFSC)**

- Relatively high and static levels of polychlorinated biphenyl (PCB) contaminants in Pacific herring from the moderately and highly developed Puget Sound basins underscore the persistence of PCBs in the pelagic food webs of nearshore, relatively enclosed marine ecosystems.
- PCBs in Puget Sound's benthic indicator species, English sole, appear to be increasing in several urbanized areas, and not decreasing in any sampled location.
- Continued tracking of persistent organic pollutants in benthic species such as English sole will continue to provide a measure of efficacy of more local cleanup or remediation efforts.

We modeled temporal trends in polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and dichlorodiphenyltrichloroethane and its metabolites (DDTs) in two indicator fish species representing benthic and pelagic habitats in Puget Sound, Washington, USA. English sole (benthic) index sites and larger-scale herring (pelagic) foraging areas represented a wide range of possible contamination conditions, with sampling locations situated adjacent to watersheds exhibiting high, medium and low development. Consistency in analytical data throughout the study was maintained by either calculating method-bias-correction factors on paired samples as methods evolved, or by analyzing older archived samples by current methods. PCBs declined moderately in two herring stocks from a low-development basin (2.3% and 4.0% annual rate of decline), and showed no change in the highly developed and moderately developed basins over a 16-year period. PCBs increased in English sole from four of ten sites (2.9% to 7.1%), and the remaining six exhibited no significant change. PBDEs and DDTs declined significantly in all herring stocks (4.2% to 8.1%), although analytical challenges warrant caution in interpreting DDT results. PBDEs declined in English sole from two high-development and one low-development site (3.7% to 7.2%), and



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

remained unchanged in the remaining seven. DDTs increased in English sole from one high development site (Tacoma City Waterway) and declined in two high-development and one low-development site. As with herring, analytical challenges warrant caution in interpreting the English sole DDT results. It is likely that source controls and mitigation efforts have contributed to the declines in PBDEs and DDTs overall, whereas PCBs appear to have persisted, especially in the pelagic food web, despite bans in PCB production and use.

Acceptance date: January 20, 2017

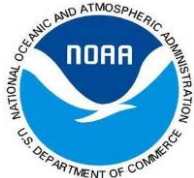
Accounting for spatial complexities in the calculation of biological reference points: effects of misdiagnosing population structure for stock status indicators
Canadian Journal of Fisheries and Aquatic Sciences (2.437)

D. R. Goethel, (NMFS/SEFSC), and A. M. Berger (NMFS/NWFSC)

- Misdiagnosing spatial population structure influences biological reference points used for management.
- Incorrectly specifying the connectivity dynamics (particularly misdiagnosing source-sink dynamics) was often more detrimental than ignoring spatial structure altogether.

Misidentifying spatial population structure may result in harvest levels that are unable to achieve management goals. We developed a spatially-explicit simulation model to determine how biological reference points (BRPs) differ among common population structures, and to investigate the performance of management quantities that were calculated assuming incorrect spatial population dynamics. Simulated reference points were compared across a range of population structures and connectivity scenarios demonstrating the influence of spatial assumptions on management benchmarks. Simulations also illustrated that applying a harvest level based on misdiagnosed spatial structure leads to biased stock status indicators, overharvesting or foregone yield. Across the scenarios examined, incorrectly specifying the connectivity dynamics (particularly misdiagnosing source-sink dynamics) was often more detrimental than ignoring spatial structure altogether. However, when the true dynamics exhibited spatial structure, incorrectly assuming panmictic structure resulted in severe depletion if harvesting concentrated on more productive population units (instead of being homogeneously distributed). Incorporating spatially-generalized operating models, such as the one developed here, into management strategy evaluations (MSEs) will help develop management procedures that are more robust to spatial complexities.

Publication date: January 26, 2017



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

Available online: <http://www.nrcresearchpress.com/doi/abs/10.1139/cjfas-2016-0290#.WMGBmVUrKos>

Does the lunar cycle affect reef fish catch rates?

North American Journal of Fisheries Management (1.013)

J. Pulver (NMFS/SEFSC)

- A lunar effect on catch rates was detected for some species of Gulf of Mexico reef fish.
- Differences in the lunar effect were present between gear types and certain species, possibly due to different mechanisms affecting catch per unit effort.

The lunar cycle was examined as a potential source of variation in catch per unit effort (CPUE) for the most common commercial reef fish species captured in the Gulf of Mexico. The analyses modeled CPUE for species captured with bottom longline and vertical line gear types using fishery observer data with two different approaches: 1) a generalized additive model (GAM) with cyclic splines to explain nonlinear variations with the 29.5-day lunar cycle, and 2) a generalized linear model (GLM) using periodic regression with the sine and cosine functions to describe cyclic variations in CPUE. A lunar effect on catch rates was detected for Red Grouper *Epinephelus morio* and Tilefish *Lopholatilus chamaeleonticeps*; however, no lunar effect was detected for Yellowedge Grouper *Hyporthodus flavolimabatus*, Red Snapper *Lutjanus campechanus*, or Vermilion Snapper *Rhomboplites aurorubens* using either method. The lunar effect in the bottom longline fishery was inconsistent between species with Red Grouper consistently having increased CPUE predicted near the new moon and for Tilefish proximal to the full moon. Red Grouper captured with vertical line gear had two increases in CPUE predicted around the waxing and waning lunar phases. Inconsistencies in lunar effect between gear types for Red Grouper were present, possibly due to different mechanisms affecting CPUE. Results suggest that lunar cycles influence catch rates for some reef fish species examined and should be considered as potential environmental covariates for standardizing nominal CPUE.

Acceptance date: February 2, 2017



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MARCH 13, 2017

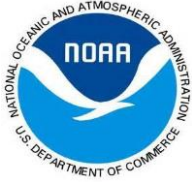
Management strategy evaluation using the individual-based, multispecies modeling approach OSMOSE

Ecological Modelling (2.275)

A. Grüss, W. J. Harford, **M. J. Schirripa**, L. Velez, **S. R. Sagarese** (NMFS/SEFSC), Y.J. Shin, and P. Verley

- This paper developed a management strategy evaluation framework for the OSMOSE model and applied this framework to the West Florida Shelf ecosystem and red grouper.
- Alternative total allowable catch (TAC) strategies were evaluated for red grouper.
- The total allowable catch update frequency impact was small in a context of episodic environmental events.

End-to-end ecosystem modeling platforms, including OSMOSE, are key tools for informing ecosystem-based fisheries management (EBFM). End-to-end models ideally implement two-way interactions between model components, yet two-way interactions between high trophic level (HTL) functional groups and humans (fisheries managers and fishers) are currently missing in OSMOSE. We developed a management strategy evaluation (MSE) framework for OSMOSE, which allows for feedback between HTL functional groups and fisheries managers. This framework couples OSMOSE to a management procedure integrating decision rules and accounting for scientific uncertainty and the acceptable risk of overfishing. We applied the MSE framework to the OSMOSE model of the West Florida Shelf, so as to conduct an evaluation of total allowable catch (TAC) strategies for red grouper (*Epinephelus morio*) in a context of episodic events of natural mortality. Our simulations indicate that TAC strategies that assume higher scientific uncertainty and/or lower acceptable risk of overfishing result in higher biomass-related metrics for red grouper. However, the levels of scientific uncertainty and acceptable risk of overfishing impose a trade-off between biomass-related and catch-related metrics for red grouper. Our simulations also indicate that updating red grouper TAC more frequently in a context of episodic events of natural mortality does not have a large impact on biomass-related and catch-related metrics for red grouper and other functional groups. The MSE we conducted for red grouper is strategic, and its outcomes, which were obtained under a specific set of assumptions, must be considered preliminary. We discuss how future research could help enhance understanding of the possible impacts of TAC strategies for red grouper. The MSE framework designed for OSMOSE links the dynamics of HTL functional groups to that of fisheries managers, thereby allowing OSMOSE to be



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

better suited for informing EBFM. This framework is an invaluable asset in assessing the performance of fisheries management strategies, but could also be used for other purposes, such as the evaluation of research monitoring programs.

Publication date: November 24, 2016

Available online:

<http://www.sciencedirect.com/science/article/pii/S0304380016304124>

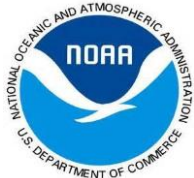
Evaluating signals of oil spill impacts, climate, and species interactions in Pacific herring and Pacific salmon populations in Prince William Sound and Copper River, Alaska

PLoS ONE (3.057)

E. J. Ward (NMFS/NWFSC), M. Adkison, J. Couture, S. C. Dressel, M. Litzow, S. Moffitt, T. Hoem Neher, J. Trochta, and R. Brenner

- This study tested a number of different hypotheses about changing productivity for sockeye, pink, and Chinook salmon as well as herring in Prince William Sound to evaluate long term effects of the Exxon Valdez Oil spill, versus other drivers related to environmental variation or increased hatchery production.
- The study found little support for long term oil spill effects at the population level, which is possibly an indicator of their resilience. For herring, we found that there were 3 recruitment failures - before, during, and after the spill, and that these periods are correlated with high freshwater discharge into the Sound.
- The study also found little support for other drivers of salmon, except a negative correlation between increased pink salmon production from hatcheries, and sockeye salmon recruits per spawner. This result is consistent with other studies in British Columbia and Alaska, showing a negative effect of pink salmon on other species.

The *Exxon Valdez* oil spill (EVOS) occurred in March 1989 in Prince William Sound, Alaska, and was one of the worst environmental disasters on record in the United States. Despite long-term data collection over the nearly three decades since the spill, tremendous uncertainty remains as to how significantly the spill affected economically-significant fishery resources. Pacific herring and wild Pacific salmon populations in Prince William Sound declined in the early 1990s, and have not returned to the population sizes observed in the 1980s. Attributing these changes entirely to the oil spill has been difficult because a number of other physical and ecological drivers are confounded temporally with the spill; some of



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

these drivers include changing climate or alternating climate regimes, increased production of hatchery salmon in the region, and increases in predator populations. Using data pre- and post-spill, we applied time-series methods to evaluate support for whether and how herring and salmon recruitment has been affected by each of five drivers (1) effects of density dependence, or decreasing population growth rate at increasing population density (2) immediate and / or prolonged impacts of the EVOS event, (3) effects of interspecific competition on juvenile fish, (4) effects of predation from adult fish or other predators, and (5) impacts of changing environmental conditions. Our results showed support for intraspecific density-dependent effects in herring, sockeye, and Chinook salmon. The inclusion of an oil spill effect was supported for pink but not supported for other salmon or herring populations. The strongest predictor of herring recruitment was freshwater discharge into Prince William Sound, supporting the idea that herring in the region experienced a series of nutritionally related recruitment failures – both before, during, and after EVOS. the *Exxon Valdez* spill. Examining historical data, there is some evidence for Prince William Sound experiencing similar dynamics over the last century (a warm regime, resulting in high freshwater discharge, poor herring recruitment, followed by a fishery collapse). These results highlight the need to better understanding the interactions between nearshore species and freshwater inputs, particularly as they relate to climate change and increasing water temperatures.

Acceptance date: February 16, 2017

Validation of band counts in eyestalks for the determination of age of Antarctic krill, Euphausia superba

PLoS ONE (3.057)

R. Kilada, **C. S. Reiss** (NMFS/SWFSC), S. Kawaguchi, R. A. King, T. Matsuda, and T. Ichii

- This paper develops a method to age krill based on striations on their eyestalks.
- This new technique provides an ability to develop age-based models of Antarctic krill, compare historical length-at-age amongst areas, and an ability to better describe the life history of Antarctic krill.

Using known-age Antarctic krill (*Euphausia superba*) grown from eggs hatched at two different laboratories, we validate the annual pattern of bands deposited in the eyestalks of krill and determine the absolute age of these animals. Ages two through five years were validated, and these animals ranged from 37.1 to 62.6 mm



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in total length. The band counts in these individuals were either identical to their absolute ages, or only failed to agree by a few months, which demonstrates the accuracy of this method. Precision and bias were estimated graphically using Chang's index (Coefficient of Variation = 5.03%). High accuracy and precision between readers and low ageing bias indicate that longitudinal sections of eyestalks can be used to age krill in wild samples and to develop age-based stock assessment models for krill. Archival samples preserved in formalin (5%) and stored in ambient conditions were also readable. Ageing preserved krill will provide the opportunity to examine changes in growth among krill populations within the Southern Ocean and to retrospectively examine changes in krill production over the last century to better understand the historical and future impacts of climate change on this critical Southern Ocean species.

Publication date: February 22, 2017

Available online:

<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0171773>

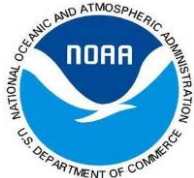
Guidelines for genetic data analysis

Journal of Cetacean Research and Management (0.80)

R. S. Waples (NMFS/NWFSC), A. R. Hoelzel, O. E. Gaggiotti, R. Tiedemann, P. J. Palsboll, F. Cipriano, J. A. Jackson, J. W. Bickham, A. R. Lang

- This paper provides practical guidelines for analysis of genetic data for conservation and management of natural populations.
- The focus is on providing guidance for evaluations of cetaceans conducted for the International Whaling Commission, but the general principles are widely applicable to other marine and terrestrial species.

An IWC workgroup recently developed guidelines for quality control of DNA data. Once data have been collected, the next step is to analyze the data and produce results that are useful for addressing practical problems in conservation and management of cetaceans. This is a complex exercise, as numerous analyses are possible and users have a wide range of choices of software programs for implementing the analyses. This document reviews the underlying issues, illustrates application of different types of genetic data analysis to two thorny management problems (involving common minke whales and humpback whales), and concludes with a number of recommendations for best practices in the analysis of population genetic data. An extensive Appendix provides a detailed review and critique of most types of analyses that are used with population genetic data for cetaceans.



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

Acceptance date: January 13, 2017

Purging putative siblings from population genetic datasets: A cautionary view
Molecular Ecology (5.947)

R. S. Waples (NMFS/NWFSC) and E. Anderson (NMFS/SWFSC)

- It is difficult to obtain random samples from natural populations, especially in the marine environment.
- Genetic samples that are derived primarily from a small number of families can lead to bias and loss of precision.
- The study shows that the increasingly-popular approach of removing putative siblings from genetics datasets often makes these problems worse rather than better.

Interest has surged recently in removing siblings from population genetic datasets before conducting downstream analyses. However, even if the pedigree is inferred correctly, this has the potential to do more harm than good. We used computer simulations and empirical samples of coho salmon to evaluate strategies for adjusting samples to account for family structure. We compared performance in full samples and sibling-reduced samples of estimators of allele frequency (P^{\wedge}), population differentiation (Fst^{\wedge}), and effective population size (Ne^{\wedge}). Results: 1) Unless simulated samples included large family groups together with a component of unrelated individuals, removing siblings generally reduced precision of P^{\wedge} and Fst^{\wedge} ; 2) Ne^{\wedge} based on the linkage-disequilibrium method was largely unbiased using full random samples but became increasingly upwardly biased under aggressive purging of siblings. Under non-random sampling (some families over-represented), Ne^{\wedge} using full samples was downwardly biased; removing just the right “Goldilocks” fraction of siblings could produce an unbiased estimate, but this sweet spot varied widely among scenarios; 3) Weighting individuals based on the inferred pedigree (to produce a best-linear-unbiased-estimator, BLUE) maximized precision of P^{\wedge} when the inferred pedigree was correct but performed poorly when the pedigree was wrong; 4) A variant of sibling removal that leaves intact small sibling groups appears to be more robust to errors in inferences about family structure. Our results illustrate the complex challenges posed by presence of family structure, suggest that no single optimal solution exists, and argue for caution in adjusting population-genetic datasets for the presence of putative siblings without fully understanding the consequences.

Publication date: February 6, 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1111/mec.14022/pdf>



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

Examining metrics and magnitudes of molecular genetic differentiation used to delimit cetacean subspecies based on mitochondrial DNA control region sequences

Marine Mammal Science (1.665)

P. E. Rosel (NMFS/SEFSC), B. L. Hancock-Hanser (NMFS/SWFSC), F. I. Archer (NMFS/SWFSC), K. M. Robertson (NMFS/SWFSC), K. K. Martien (NMFS/SWFSC), M. S. Leslie (NMFS/SWFSC), A. Berta, F. Cipriano, A. Viricel (NMFS/SEFSC), K. A. Vlaud-Martinez, B. L. Taylor (NMFS/SWFSC)

- Some metrics of genetic differentiation work better than others for distinguishing cetacean subspecies and species.
- The paper provides a means to standardize across studies the estimate of genetic differentiation between cetacean subspecies and cetacean species.

Cetacean taxonomy continues to be in flux and molecular genetic analyses examining alpha taxonomy in cetaceans have relied heavily on the mitochondrial DNA control region. However, there has been little consistency across studies; a variety of metrics and levels of divergence have been invoked when delimiting new cetacean species and subspecies. Using control region sequences, we explored, across pairs of well-recognized cetacean populations, subspecies, and species, a suite of metrics measuring molecular genetic differentiation to examine which metrics best categorize these taxonomic units. Nei's estimate of net divergence (d_A) and percent diagnosability performed best. All but a single, recently diverged species were unambiguously identified using these metrics. Many subspecies were found at intermediate values as expected, allowing separation from both populations and species, but several had levels of divergence equivalent to populations, resulting in underclassification errors using this single marker. Coupling d_A with additional measures, such as percent diagnosability, examining appropriate nuclear genetic markers, and interpreting results in a broader biological context will improve taxonomic investigations in cetaceans.

Acceptance date: January 8, 2017

A right whale pootree: Classification trees of fecal hormones identify reproductive states in North Atlantic right whales (Eubalaena glacialis)

Conservation Physiology (2.98)

P. Corkeron (NMFS/NEFSC), R. M. Rolland, K. E. Hunt, and S. D. Kraus

- The study assessed the reliability of detecting the reproductive state of critically endangered North Atlantic right whales using hormone metabolites from fecal samples.



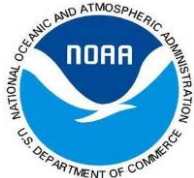
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MARCH 13, 2017

- Classification trees, a multivariate approach, worked well to describe the reproductive states of North Atlantic right whales.
- The reproductive state of these whales is important to understanding the relationship between cortisol levels and stress detected in fecal samples.

Immunoassay of hormone metabolites extracted from fecal samples of free-ranging large whales can provide biologically relevant information on reproductive state and stress responses. North Atlantic right whales (*Eubalaena glacialis* Müller 1776) are an ideal model for testing fecal metabolites' conservation value. Almost all North Atlantic right whales are individually identified, most of the population is sighted each year, and systematic survey effort extends back to 1986. North Atlantic right whales number less than 500 individuals and are subject to anthropogenic mortality, morbidity and other stressors, and scientific data to inform conservation planning are recognized as important. Here we describe the use of classification trees as an alternative method of analyzing multiple-hormone datasets, building on univariate models that have previously been used to describe hormone profiles of individual North Atlantic right whales of known reproductive state. Our tree correctly classified age class, sex, and reproductive state of 83% of 112 fecal samples from known individual whales. Pregnant females, lactating females, and both mature and immature males were classified reliably using our model. Non-reproductive (i.e. "resting" — not pregnant and not lactating — and immature) females proved the most unreliable to distinguish. There were three individual males that, given their age, would traditionally be considered immature but that our tree classed as mature males, possibly calling for a re-evaluation of their reproductive status. Our analysis re-iterates the importance of considering the reproductive state of whales when assessing the relationship between cortisol levels and stress. Overall these results confirm findings from previous univariate statistical analyses, but with a more robust multivariate approach that may prove useful for the multiple-analyte datasets that are increasingly employed by conservation physiologists.

Acceptance date: January 14, 2017



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

Cetacean sightings and acoustic detections during a seismic survey off Nicaragua and Costa Rica, November-December 2004

International Journal of Tropical Biology and Conservation/Revista de Biología Tropical (0.544)

M. Holst, M. A. Smultea, W. R. Koski, A. J. Sayegh, G. Pavan, J. Beland, and **H. H. Goldstein (NMFS/OPR)**

- A visual-acoustic survey for cetaceans across Nicaragua and Costa Rica's shelf and slope zones provided baseline cetacean data to address data gaps in Central American cetacean surveys.
- Of 2067 cetacean sightings, the humpback whale and pantropical spotted dolphin were most sighted, followed by 4 other confirmed dolphin species and short-finned pilot whales.
- Concentrations of humpback whales unknown to occur in the Gulf of Fonseca were recorded, as were a mother-calf pair off Costa Rica.

A visual-acoustic survey for cetaceans occurred during an academic geophysical seismic study off Nicaragua and Costa Rica during November–December 2004. Although the wider Eastern Tropical Pacific (ETP) has been systematically surveyed during summer/fall, relatively little effort has focused on shelf and slope waters in our study area. Such data are useful for establishing baseline information and assessing potential changes in cetacean occurrence and distribution relative to natural (*e.g.*, El Niño–Southern Oscillation, climate change) and anthropogenic factors. Approximately 2067 cetaceans representing at least seven species were seen in 75 groups during 373 h (3416 km) of daytime observations from the seismic research vessel (R/V) Maurice Ewing. The humpback whale (*Megaptera novaeangliae*) and the pantropical spotted dolphin (*Stenella attenuata*) were the most frequently sighted species (30 % of all groups sighted), followed by the bottlenose dolphin (*Tursiops truncatus*; 10 % of sightings). In addition, sightings were made of spinner dolphins (*S. longirostris*), short-beaked common dolphins (*Delphinus delphis*), Risso's dolphins (*Grampus griseus*), short-finned pilot whales (*Globicephala macrorhynchus*), and unidentified dolphins and whales.

Unconfirmed sightings of a minke whale (*Balaenoptera acutorostrata*) and a pod of false killer whales (*Pseudorca crassidens*) were also made. An additional six sightings of dolphins (50 % confirmed to species, all pantropical spotted dolphins) were made during 187 h (1549 km) of observation effort during darkness, and 217 passive acoustic detections occurred. A small concentration of 12 humpback whales was seen in eight groups, and two humpbacks were recorded singing in the Gulf of Fonseca on 9 December 2004. To our knowledge, such concentrations of



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

humpback whales, particularly singing humpbacks, have not been previously reported in this specific area. In addition, a humpback mother-calf pair, likely from the Northern Hemisphere population, was seen off northern Costa Rica on 25 November 2004. Our survey results address previous data gaps on cetacean occurrence in shelf and slope waters off the Pacific coast of Central America during late fall.

Acceptance date: January 11, 2017

Species-specific responses of demersal fishes to near-bottom oxygen levels within the California Current large marine ecosystem

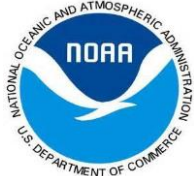
Marine Ecology Progress Series (2.361)

A. A. Keller (NMFS/NWFSC), L. Ciannelli, W. W. Wakefield

(NMFS/NWFSC), V. H. Simon (NMFS/NWFSC), J.A. Barth, and S. D. Pierce

- Long-term environmental sampling provided information on catch and near-bottom oxygen levels across a range of depths and conditions from the upper to the lower limit of the oxygen minimum zone and shoreward across the continental shelf of the U.S. west coast (U.S. - Canada to U.S. - Mexico).
- Significant positive relationships between catch per unit effort and near-bottom dissolved oxygen concentrations occurred for 19 of 34 groundfish species within hypoxic bottom waters, with an apparent threshold effect at lower oxygen levels meaning that small changes in oxygen produced large changes in catch.
- Community effects (total CPUE and species richness for demersal fishes) also exhibited significant and positive relationships with low near-bottom oxygen levels.

Long-term environmental sampling provided information on catch and near-bottom oxygen levels across a range of depths and conditions from the upper to the lower limit of the oxygen minimum zone and shoreward across the continental shelf of the U.S. west coast (U.S. – Canada to U.S. – Mexico). During 2008 – 2014, near-bottom dissolved oxygen concentrations (DO) ranged from 0.02 to 5.5 mL L⁻¹ with 63.2% of sites experiencing hypoxia (DO < 1.43 mL L⁻¹). The relationship between catch per unit effort (CPUE) and DO was estimated for 34 demersal fish species in five subgroups by life history category (roundfishes, flatfishes, shelf rockfishes, slope rockfishes and thornyheads) using Generalized Additive Models. Models included terms for position, time, near-bottom environmental measurements (salinity, temperature, oxygen) and bottom depth. Significant positive relationships between CPUE and DO occurred for 19 of 34



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

groundfish species within hypoxic bottom waters. Community effects (total CPUE and species richness for demersal fishes) also exhibited significant and positive relationships with low near-bottom oxygen levels. GAM analysis revealed an apparent threshold effect at lower oxygen levels, where small changes in oxygen produced large changes in catch for several species, as well as total catch and species richness. An additional seven species displayed negative trends. Based on AIC-values, near-bottom oxygen played a major role in the distribution of flatfishes, roundfishes and thornyheads. By examining similarities and differences in the response of various subgroups of commercially important groundfish species to low DO levels, we uncovered ecological inferences of potential value to future ecosystem-based management.

Acceptance date: January 24, 2017

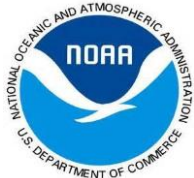
Intraspecific variability in the life history of endemic coral reef fishes between photic and mesophotic depths in the central Pacific Ocean

Coral Reefs (3.000)

M. S. Winston, **B. M. Taylor (NMFS/PIFSC)**, and E. C. Franklin

- The study found intraspecific variability in life history of coral reef fishes across shallow and mesophotic reefs.
- Mesophotic reef fishes in the central Pacific had lower body condition and weight-at-length than photic reefs.
- The highest body condition and largest body size were recorded in the Northwestern Hawaiian Islands compared to the Main Hawaiian Islands and Johnston Atoll.
- Distinct conservation goals and fisheries management may be needed for conspecifics at different reef depths.

For many coral reef-associated organisms, mesophotic coral ecosystems (MCEs) represent the lowest depth distribution inhabited by their species. Research on fishes associated with MCEs is sparse, so there is a critical lack of knowledge of how reef fish found at mesophotic depths may vary from their shallow reef conspecifics. We investigated intraspecific variability in body condition and growth of three Hawaiian endemics collected from shallow, photic reefs (5-33 m deep) and MCEs (40-75 m) throughout the Hawaiian Archipelago and Johnston Atoll: the detritivorous goldring surgeonfish *Ctenochaetus strigosus*, and the planktivorous threespot chromis *Chromis verater* and Hawaiian dascyllus *Dascyllus albisella*. Estimates of body condition, weight-at-length, and size-at-age varied between shallow and mesophotic depths, and among the locations sampled



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

within the central Pacific. All three species exhibited lower body condition and weight-at-length in pooled mesophotic sites. However, there was no difference in age-based growth curves between pooled shallow and mesophotic sites. Body condition and maximum body size were lowest in samples collected from shallow and mesophotic Johnston Atoll sites, with no difference occurring between depths. Samples from the Northwestern Hawaiian Islands tended to have the highest body condition and reached the largest body sizes, with differences between shallow and mesophotic sites found to be highly variable between species. The findings of this study are first to demonstrate intraspecific variability in the life history of coral reef fish species whose distributions span shallow and mesophotic reefs. This information suggests that the application of conservation and fisheries management tools developed from studies of shallow reef fishes should be applied with caution to conspecific populations in mesophotic coral environments.

Publication date: February 28, 2017

Available online: <https://link.springer.com/article/10.1007/s00338-017-1559-8>

Human-mediated evolution in a threatened species? Juvenile life-history changes in Snake River salmon

Evolutionary Applications (4.572)

R. S. Waples, A. Elz, B. D. Arnsberg, **J. R. Faulkner** , **J. J. Hard**, E. Timmins-Schiffmann, **L. K. Park** (NMFS/NWFSC)

- In recent years the threatened Snake River fall Chinook salmon population began migrating to sea as yearlings instead of migrating as subyearlings suggesting evolution caused by changes in hydropower development may be partially responsible for this life-history change.
- Results suggest an increase in juvenile growth rate allowing them to migrate to sea earlier, and adults who had an increased growth rate as juvenile pass this trait to their offspring.

It is widely recognized that the human footprint is large in all of Earth's ecosystems, but evaluations of the consequences of this reality often ignore evolutionary changes in response to altered selective regimes. Habitats for Snake River fall Chinook salmon (SRFCS), a threatened species in the U.S., have been dramatically changed by hydropower development. Associated biological changes include a shift in juvenile life history: historically ~100% of juveniles migrated to sea as subyearlings, but a substantial fraction have migrated as yearlings in recent years. In contemplating future management actions for this species should major Snake River dams ever be removed (as many have proposed), it will be important



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

to understand whether evolution is at least partially responsible for this life-history change. We hypothesized that if this trait is genetically based, parents who migrated to sea as subyearlings should produce faster-growing offspring that would be more likely to reach a size threshold to migrate to sea in their first year. We tested this with phenotypic data for >2600 juvenile SRFCS that were genetically matched to parents. Three lines of evidence supported our hypothesis: 1) the animal model estimated substantial heritabilities for juvenile growth rate for three consecutive cohorts; 2) linear modeling showed an association between juvenile life history of parents and offspring growth rate; and 3) faster-growing juveniles migrated faster, as expected if they were more likely to be heading to sea. Surprisingly, we also found that parents reared a full year in a hatchery produced the fastest-growing offspring of all—apparently an example of cross-generational plasticity associated with artificial propagation. We suggest that SRFCS is an example of a potentially much larger class of conservation-reliant species that can also be considered to be “anthro-evolutionary”—signifying those whose evolutionary trajectories have been profoundly shaped by altered selective regimes in human-dominated landscapes.

Publication date: February 10, 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1111/eva.12468/full>

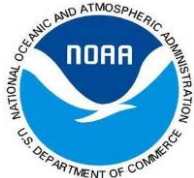
Progress towards a next-generation fisheries ecosystem model for the northern Gulf of Mexico

Ecological Modelling (2.275)

S. R. Sagarese, M. V. Laretta, and J. F. Walter III (NMFS/SEFSC)

- The authors developed a mass-balanced Ecopath model integrating ecosystem stressors and fisheries bycatch in the northern Gulf of Mexico.
- A network analysis evaluated impacts of fisheries and red tide events on species.
- A meta-analysis of diet composition filled critical gaps in predator-prey linkages revealed detrimental effects of red tides on sharks, skates and rays, and fishes.

Catastrophic disturbances to marine environments, such as the Deepwater Horizon oil spill in the northern Gulf of Mexico (GoM), emphasize the need to approach fisheries management and restoration from an ecosystem perspective. To evaluate the ecosystem dynamics within the GoM, we developed a mass-balanced Ecopath model (“nGoM Ecopath”) which integrated ecosystem stressors, indirect effects of fishing (e.g. bycatch), and predator-prey dynamics. A meta-analysis of diet



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

composition filled critical gaps in higher trophic level predator-prey linkages, such as predation on economically important groupers (Serranidae). Compared to previous Ecopath models of the GoM, nGoM Ecopath displayed higher ecosystem complexity including higher connectivity amongst trophic groups and increased omnivory. Mixed trophic impact analysis revealed species including snappers, groupers, pelagic coastal piscivores, oceanic piscivores, cephalopods, and dolphins as critical top-down predators. Bottom-up effects were identified for juvenile groupers and mackerels, which benefited from high production of invertebrates and small fishes. Network analysis revealed detrimental effects of red tides on sharks, skates and rays, and demersal coastal invertebrate feeders such as black drum, as well as adult red and gag grouper. Pelagic coastal piscivores (e.g. jacks (Carangidae), snappers (Lutjanidae), and mobile epifauna (e.g. lobsters) imposed the largest influence on ecosystem structure as keystone predators. The nGoM Ecopath model using the dynamic module Ecosim can help guide restoration efforts through the evaluation of multispecies responses to management actions and identification of ecosystem trade-offs.

Publication date: February 10, 2017

Available online:

<http://www.sciencedirect.com/science/article/pii/S0304380016306512>

Risky business for a juvenile marine predator? An indirect test of the influence of foraging strategies and natural selection on size and growth rate in the wild
Proceedings of the Royal Society of London Series B (4.823)

N. Hussey, J. DiBattista, J. W. Moore, **E. J. Ward (NMFS/NWFSC)**, A. Fisk, S. Kessel, T. Guttridge, K. Feldheim, B. Franks, S. Gruber, O. Weideli, and D. Chapman

- Growth rates/size differences between different known juvenile lemon shark habitats was investigated using a long-term dataset of juvenile lemon sharks that forage in multiple habitats (protected mangroves, exposed seagrass beds).
- These results suggest in exposed seagrass beds larger, faster growing individuals forage when compared to mangroves, where smaller juveniles forage.
- These results suggest that in exposed areas where risk from predation may be high, selection may favor smaller/slower-growing individuals.

Mechanisms driving selection of body size and growth rate in wild marine vertebrates are poorly understood limiting our knowledge of their fitness costs at



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

ecological, physiological and genetic scales. Here, we indirectly test selection for size related traits of juvenile sharks that inhabit a nursery hosting two dichotomous habitats, protected mangroves and exposed seagrass beds, each with low and high inherent predation risk. Juvenile sharks displayed a continuum of foraging strategies between mangrove and seagrass areas, with individuals preferentially feeding in one habitat over another. Foraging habitat was correlated with growth rate, whereby slower growing, smaller individuals fed predominantly in sheltered mangroves, whereas larger, faster growing animals fed over exposed seagrass. These data provide evidence for variable body size trait trajectories amongst juveniles within the nursery that do not satisfy the phenotypic optimum, which means selection can favour smaller size and slower growth rate. The direction of body size trait selection under natural conditions is likely more plastic than currently assumed and may be a critical to adaptation within predator driven ecosystems.

Acceptance date: February 21, 2017

Combining functional data with hierarchical Gaussian process models

Environmental and Ecological Statistics (0.769)

V. Poynor and S. B. Munch (NMFS/SWFSC)

- The authors developed a hierarchical approach to combining functional data from multiple sources.

Gaussian process models have been used in applications ranging from machine learning to fisheries management. In the Bayesian framework, the Gaussian process is used as a prior for unknown functions, allowing the data to drive the relationship between inputs and outputs. In our research, we consider a scenario in which response and input data are available from several similar, but not necessarily identical, sources. When little information is known about one or more of the populations it may be advantageous to model all populations together. We present a hierarchical Gaussian process model with a structure that allows distinct features for each source as well as shared underlying characteristics. Key features and properties of the model are discussed and demonstrated in a number of simulation examples. The model is then applied to a data set consisting of three populations of Rotifer *Brachiomus clyciflorus* Pallas. Specifically, we model the log growth rate of the populations using a combination of lagged population sizes. The various lag combinations are formally compared to obtain the best model inputs. We then formally compare the leading hierarchical Gaussian process model with



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

the inferential results obtained under the independent Gaussian process model.

Publication date: February 17, 2017

Available online: <https://link.springer.com/article/10.1007/s10651-017-0366-2>

Age and growth of juvenile green turtles (Chelonia mydas) in the western South Atlantic Ocean

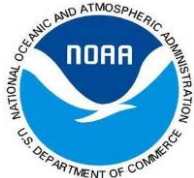
Marine Ecology Progress Series (2.361)

A.J. Lenz, L. Avens (NMFS/SEFSC), M. Borges-Martins

- Age structure and age at recruitment was characterized for endangered green sea turtles inhabiting neritic foraging habitat in Brazil.
- Analyses yielded somatic growth rate data spanning 16 years and allowed characterization of the influence of size, age, and year on growth.
- Results of this study provide age and growth data needed for management of endangered green sea turtles in the western South Atlantic Ocean, a region where this information is lacking.

The green turtle (*Chelonia mydas*) has a circumglobal distribution and is globally Endangered. This long-lived, migratory turtle has a spatially complex life cycle that encompasses initial development in oceanic habitat, with subsequent recruitment to neritic habitat. In the coastal waters of the western South Atlantic Ocean, juvenile green turtles are a notable component of the marine megafauna. As a result of incidental capture and other anthropogenic causes, dead specimens are commonly found stranded on beaches. Knowledge of age and growth is critical to understanding population life history and dynamics, as well as for conservation planning. We applied skeletochronology to estimate age and growth rates for green turtles stranded throughout 16 years (1994-2010) in southern Brazil. Curved carapace length (CCL) ranged from 31 to 61 cm (mean = 41 cm) and estimated ages from 2 to 13 years (mean = 5 yr). Green turtles recruit to the neritic environment in this area around 30 cm CCL and 2 to 3 years of age, remaining in this region until reach approximately 50 cm CCL and 7 years of age. The mean growth rate of the whole sample was 3.7 cm CCL yr⁻¹ and both age and size had a significant influence on growth. This study is the first to estimate green turtles' age and growth in the South Atlantic and also the first to describe the recruitment age for juveniles in this region.

Acceptance date: January 11, 2017



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

Improving detection of short-duration fishing behaviour in vessel tracks by feature engineering of training data

ICES Journal of Marine Science (2.801)

S. O'Farrell, J. N. Sanchirico, I. Chollett, M. Cockrell, S. A. Murawski, **J. T. Watson (NMFS/AKFSC), A. Haynie (NMFS/AKFSC), A. Strelcheck (NMFS/SERO), and L. Perruso (NMFS/SEFSC)**

- Vessel monitoring system data can improve the estimation of effort from unobserved fishing.

Big data, such as vessel monitoring system (VMS) data, can provide valuable information on fishing behaviours. However, conventional methods of detecting behaviours in movement data are challenged when behaviours are briefer than signal resolution. We investigate options for improving detection accuracy for short-set fisheries using 581 648 position records from 181 vessels in the Gulf of Mexico bandit-reel fishery. We first investigate the effects of increasing VMS temporal resolution and find that detection accuracy improves with fishing-set duration. We then assess whether a feature engineering approach—in our case, changing the way pings are labelled when training a classifier—could improve detection accuracy. From a dataset of 12 184 observed sets, we find that the conventional point-labelling method results in only 49% of pings being correctly labelled as 'fishing', whereas a novel window-labelling method results in 88% of records being labelled as 'fishing'. When the labelled data are used to train classifiers, point labelling attains true-positive/balanced-accuracy rates of only 37%/66%, whereas window labelling achieves 68%/83%. Finally, we map fishing distribution using the two methods, and show that point labelling underestimates the extent of fishing grounds by _33%, highlighting the benefits of window labelling in particular, and feature engineering approaches in general.

Acceptance date: December 7, 2016

Population assessment using multivariate time-series analysis: A case study of rockfishes in Puget Sound

Ecology and Evolution (2.537)

N. Tolimieri, E. E. Holmes (NMFS/NWFSC), G. Williams, R. Pacunski, and D. Lowry

- This study used data from citizen science, independent trawl surveys, and recreational fishery surveys to track population estimates.
- This statistical approach for data poor species will allow population viability analysis in cases where data are limiting for more traditional analyses.



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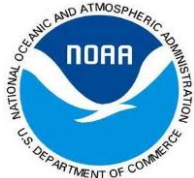
MARCH 13, 2017

Estimating a population's growth rate and year-to-year variance is a key component of population viability analysis (PVA). However, standard PVA methods require time series of counts obtained using consistent survey methods over many years. In addition, it can be difficult to separate observation and process variance, which is critical for PVA. Time-series analysis performed with multivariate autoregressive state-space (MARSS) models is a flexible statistical framework that allows one to address many of these limitations. MARSS models allow one to combine surveys with different gears and across different sites for estimation of PVA parameters, and allows one to implement replication, which reduces the variance-separation problem and maximizes informational input for mean trend estimation. Even data that are fragmented with unknown error levels can be accommodated. We present a practical case study that illustrates MARSS analysis steps: data choice, model set-up, model selection, and parameter estimation.

Our case study is an analysis of the long-term trends of rockfish in Puget Sound, Washington based on citizen science scuba surveys, a fishery-independent trawl survey, and recreational fishery surveys affected by bag-limit reductions. The best-supported models indicated that the recreational and trawl surveys tracked different, temporally-independent assemblages that declined at similar rates (an average -3.8 to -3.9% per year). The scuba survey tracked a third increasing and temporally-independent assemblage (an average 4.1% per year).

Three rockfishes (bocaccio, canary, and yelloweye) are listed in Puget Sound under the US Endangered Species Act (ESA). These species are associated with deep water, which the recreational and trawl surveys sample better than the scuba survey. All three ESA-listed rockfishes declined as a proportion of recreational catch between the 1970s and 2010s suggesting that they experienced similar or more severe reductions in abundance than the 3.8–3.9% per year declines that were estimated for rockfish populations sampled by the recreational and trawl surveys.

Acceptance date: February 21, 2017



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

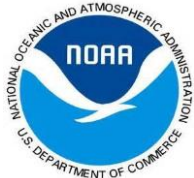
Highly localized replenishment of coral reef fish populations near nursery habitats Marine Ecology Progress Series (2.361)

I. Nagelkerken, K. B. Huebert, **J. E. Serafy (NMFS/SEFSC)**, M. G. G. Grol, M. Dorenbosch, and C. J. A. Bradshaw

- This study suggests local conservation/management (or lack thereof) of nearshore nursery habitats can have local reef fishery and ecosystem impacts.
- The results demonstrate that for several species, enhancement of adult reef populations by mangrove and seagrass nurseries is highly localized and the magnitude of this enhancement is highly correlated with juvenile population abundances within the nursery habitats.

Connectivity is essential for ecosystem functioning, and in particular for the population dynamics of species that use different habitats during consecutive life stages. Mangrove and seagrass habitats serve to replenish populations of a range of species that live on coral reefs, but we know little about the fate of these early stages and the spatial scale at which adult populations benefit from this enhancement effect. We examined densities of 12 ecologically important Caribbean fish species across three nursery-dependency categories (high, low, none). We tested the hypotheses that for nursery species: (i) densities and (ii) biomass in the adult habitat decrease with distance from nurseries as the enhancement effect is progressively diluted, and (iii) densities in the adult habitat are positively correlated with total juvenile abundance in nurseries. Reef density and biomass of the high- and low-dependence species declined rapidly within ~ 4 km from nurseries, while at a distance of ~ 14 km densities of most species were close to zero. These patterns were not confounded by local habitat complexity. Density and biomass of the no-dependence species remained unchanged with distance. Total abundance of juvenile fishes in nurseries was a good predictor of total adult abundance on adjacent reefs for the high-dependence species. Our results demonstrate that for several species, enhancement of adult reef populations by mangrove and seagrass nurseries is highly localized ($< \sim 4$ km) in terms of abundance and biomass, and the magnitude of this enhancement is highly correlated with juvenile population abundances within the nursery habitats.

Acceptance date: January 23, 2017



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

Ocean size and corresponding life history diversity among the four run timings of California Central Valley Chinook salmon

Transactions of the American Fisheries Society (1.469)

W. H. Satterthwaite (NMFS/SWFSC), S. M. Carlson, and A. Criss (NMFS/SWFSC)

- The authors documented differences in spawner age structure and seasonal patterns of age-specific size-at-date in the ocean among the four seasonal run timings (fall, late-fall, winter, and spring) of Chinook salmon from the Central Valley, California, and examined differences between fall run (the most abundant) from the Sacramento and San Joaquin basins.
- Despite support for multiple hypotheses, no single factor explained all the variation among and within runs.
- The results demonstrate multiple pathways by which differences both within and among the runs may contribute to differences in their fishery vulnerability, age structure, and demographic decoupling; all of which could contribute to a stabilizing portfolio effect.

We used coded-wire tag data to compare spawner age structure and seasonal patterns of age-specific size-at-date among fish harvested in the ocean from the four seasonal run timings (fall, late-fall, winter, and spring) of Chinook salmon from the Central Valley, California, and examined differences between fall run (the most abundant) from the Sacramento and San Joaquin basins. The runs varied in their ocean size at a common age and date, and within each run, monthly mean ocean sizes appeared to stop increasing when spawners began to return to freshwater. Despite support for multiple hypotheses, no single factor explained all the variation among and within runs. Ocean size at a common date was well explained by a "juvenile head start" hypothesis predicting larger sizes for spring and fall run due to earlier ocean entry. Month of spawner return was well explained by a "premature adult migration" hypothesis predicting earlier returns (within years, regardless of age) by winter and spring run fish spawning further upstream. However, neither release timing nor spawning elevation could fully explain observed patterns in spawner age structure, such as unusually high occurrence of age 2 San Joaquin fall run spawners and the near absence of age 4 or older spawners in winter run. Larger smolt size might explain earlier maturation by San Joaquin versus Sacramento fall run, but smolt size could not explain patterns in age structure across runs. Metabolic costs of holding upstream with large size might explain the lack of older spawners among winter run, but is inconsistent with late-fall run having the highest frequency of age 4 and older spawners. Our results



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demonstrate multiple pathways by which differences both within and among the runs may contribute to differences in their fishery vulnerability and demographic decoupling, which could contribute to a stabilizing portfolio effect.

Acceptance date: February 2, 2017

Estimating partial regulation in spatio-temporal models of community dynamics
Ecology (5.175)

J. Thorson (NMFS/NWFSC), S. B. Munch (NMFS/SWFSC), and D. Swain

- The authors develop a new approach to parsimoniously estimate community interactions and how they vary in space

Niche-based approaches to community analysis often involve estimating a matrix of pairwise interactions among species (the “community matrix”), but this task becomes infeasible using observational data as the number of modeled species increases. As an alternative, neutral theories achieve parsimony by assuming that species within a trophic level are exchangeable, but generally cannot incorporate stabilizing interactions even when they are evident in field data. Finally, both regulated (niche) and unregulated (neutral) approaches have rarely been fitted directly to survey data using spatio-temporal statistical methods. We therefore propose a spatio-temporal and model-based approach to estimate community dynamics that are partially regulated. Specifically, we start with a neutral spatio-temporal model where all species follow ecological drift, which precludes estimating pairwise interactions. We then add regulatory relations until model selection favors stopping, where the “rank” of the interaction matrix may range from zero to the number of species. A simulation experiment shows that model selection can accurately identify the rank of the interaction matrix, and that the identified spatio-temporal model can estimate the magnitude of species interactions. A forty-year case study for the Gulf of St. Lawrence marine community shows that recovering grey seals have an unregulated and negative relation with demersal fishes. We therefore conclude that partial regulation is a plausible approximation to community dynamics using field data, and hypothesize that estimating partial regulation will be expedient in future analyses of spatio-temporal community dynamics given limited field data. We conclude by recommending ongoing research to add explicit models for movement, so that meta-community theory can be confronted with data in a spatio-temporal statistical framework.

Acceptance Date: February 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/ecy.1760/full>



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

Phylogenetics and biogeography of the two-wing flyingfish (Exocoetidae: Exocoetus)

Ecology and Evolution (2.537)

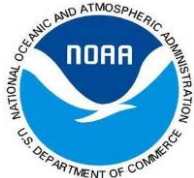
E. A. Lewallen, A. J. Bohonak, C. A. Bonin, A. J. van Wijnen, **R. L. Pitman** (NMFS/SWFSC), and N. R. Lovejoy

- This paper provides a phylogeny and biogeography of two-winged flyingfish with some discussion about speciation among pantropical, epipelagic organisms.
- The phylogeny indicates that the most spatially restricted species are more recently derived.

Two-wing flyingfish (*Exocoetus* spp.) are widely distributed, epipelagic, mid-trophic organisms that feed on zooplankton and are preyed upon by numerous predators (e.g., tunas, dolphinfish, tropical seabirds), yet an understanding of their speciation and systematics is lacking. As a model of epipelagic fish speciation and to investigate mechanisms that increase biodiversity, we studied the phylogeny and biogeography of *Exocoetus*, a highly abundant holoepipelagic fish taxon of the tropical open ocean. Morphological and molecular data were used to evaluate the phylogenetic relationships, species boundaries, and biogeographic patterns of the five putative *Exocoetus* species. We show that the most widespread species (*E. volitans*) is sister to all other species, and we find no evidence for cryptic species in this taxon. Sister relationship between *E. monocirrhus* (Indo-Pacific) and *E. obtusirostris* (Atlantic) indicates the Isthmus of Panama and/or Benguela Barrier may have played a role in their divergence via allopatric speciation. The sister species *E. peruvianus* and *E. gibbosus* are found in different regions of the Pacific Ocean; however, our molecular results do not show a clear distinction between these species, indicating recent divergence or ongoing gene flow. Overall, our phylogeny indicates that the most spatially restricted species are more recently derived, suggesting that allopatric barriers may drive speciation, but subsequent dispersal and range expansion may affect the distributions of species.

Acceptance Date: February 12, 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/ece3.2786/full>



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

Spawning locations and larval dispersal of Atlantic Menhaden during 1977-2013
ICES Journal of Marine Science (2.626)

Simpson, Bi, Liang, Wilberg, **A. Schueller (NMFS/SEFSC-Beaufort)**, Nesslage,
H. J. Walsh (NMFS/NEFSC)

- Atlantic menhaden spawn over a large spatial range over the majority of the year.
- The study found no apparent shifts in spawning locations.
- Larval supply does not seem to limit recruitment for Menhaden populations.

Atlantic Menhaden *Brevoortia tyrannus* exhibit particularly complex recruitment dynamics as a coastal-spawning species with seasonal migrations along the North American Coast from Nova Scotia, Canada, to Florida, United States. Despite a coast-wide reduction in juvenile production from the 1970s to the 1990s, Atlantic Menhaden continues to support one of the oldest and largest commercial fisheries on the US east coast. We used a stochastic partial differential equation model to estimate spawning location and larval dispersal on the Atlantic Coast over two time periods, with data from the Northeast Fisheries Science Center ichthyoplankton surveys conducted in 1977-1987 and 2000-2013. Within the study area, Atlantic Menhaden spawning appears to occur primarily near shore over a large spatial range, from southern New England to North Carolina over the majority of the year, but at greatest levels during November and December. Larger, older larvae were found over a similar spatial and temporal range, dispersing farther from shore. Between the two periods, we observed an increase in secondary, spring-time spawning events. We observed no major, directional spatial shift in spawning or dispersal. However, estimated spawning activity increased near Delaware Bay. Both small and large larvae were most abundant in the Southern portion of the study area during both periods. Yet, total spatial coverage of all larvae varied greatly among years until the mid-2000s, when the Atlantic Menhaden population was believed to have recovered reduction in juvenile production from the 1970s to the 1990s. In most recent years, we observed consistent and large areas of spawning and larval dispersal.

Acceptance date: February 10, 2017



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

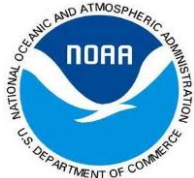
Linear correlations in bamboo coral $d^{13}C$ and $d^{18}O$ sampled by SIMS and micromill: evaluating paleoceanographic potential and biomineralization mechanisms using $d^{11}B$ and Δ_{47} composition

Chemical Geology (3.482)

C. Saenger, R. I. Gabitov, J. Farmer, J. M. Watkins, and **R. P. Stone**
(NMFS/AKFSC)

- This paper provides important new methodology to use deep-sea corals as paleoceanographic archives with the potential to reconstruct variations throughout the water column over multiple centuries.
- The study provides important new insights on historical oceanographic conditions in the Gulf of Alaska and North Pacific Ocean.

Bamboo corals represent an intriguing paleoceanographic archive with the potential to reconstruct variations throughout the water column over multiple centuries. Realizing this potential partially depends on if, and at what resolution, timeseries of variability can be generated. Recent work demonstrates that bamboo coral growth temperature, averaged over its entire lifespan, can be derived from linear correlations in its carbon and oxygen isotope composition ($d^{13}C$, $d^{18}O$) when the apparent equilibrium fractionations for a coral's growth rate and calcifying pH are used. Building on this method, this study applies it to coeval coral skeleton to assess the possibility of extracting paleoceanographic timeseries from bamboo coral skeletons. Using boron isotope ($d^{11}B$) based pH estimates, micromilled samples yield accurate paleotemperatures with uncertainties of $<2^{\circ}C$, whose precision could be improved to $<1^{\circ}C$ if additional sampling yielded more robust regressions. This provides strong evidence that decadal-scale temperature reconstructions may be extracted from bamboo corals. Complementary SIMS data generated at annual to inter-annual resolution often yield accurate temperatures, but with greater uncertainty that is always $>2^{\circ}C$. This is attributed to the inability to measure $d^{13}C$ and $d^{18}O$ in exactly the same skeleton, as is the case for micromilled samples. A micromilled sampling strategy is therefore likely the most practical means of applying the method. Carbonate clumped isotopes (Δ_{47}) estimate temperatures slightly warmer than observed, suggesting they may not accurately record the subtle variations of the latest Holocene. When interpreted in conjunction, $d^{18}O$, $d^{11}B$ and Δ_{47} data suggest that pH up-regulation plays a role in generating linear $d^{13}C$ - $d^{18}O$ trends. However, oxygen isotope fractionation and Δ_{47} are lower than would be predicted by pH alone. Potential explanations for this discrepancy include biological processes that favor the incorporation of carbonate ion into coral skeleton, uncertainties in the $d^{11}B$ -pH proxy, the influence of



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

magnesium on calcite-fluid isotope fractionation, or uncertainties in the fractionation factors used to calculate apparent equilibrium.

Publication date: April 2017

Available online:

<http://www.sciencedirect.com/science/article/pii/S000925411730092X>

Life history of the orange-striped emperor Lethrinus obsoletus from the Mariana Islands

Ichthyological Research (1.023)

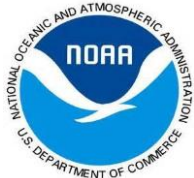
B. M. Taylor, Z. S. Oyafuso, M. S. Trianni (NMFS/PIFSC)

- This study provides detailed life-history information of value to stock assessment and regional fisheries management and additional preliminary investigation of phylogenetic signals in patterns of life history among the lethrinids.

The present study investigated the age-based demography of the orange-striped emperor, *Lethrinus obsoletus*, from commercial samples in the Commonwealth of the Northern Mariana Islands (CNMI), spanning a 24-month market sampling period. Information on growth, life span, mortality, and reproduction was derived through analysis of sectioned sagittal otoliths and gonad material. The species had a moderate longevity of 13 years while females and males reached 50 % sexual maturity at 3.8 years (22.9 cm fork length) and 2.8 years (19.9 cm fork length), respectively. Histological examination of gonads and sex-specific age frequency distributions suggest the sexual ontogeny of the species conforms to juvenile hermaphroditism, whereby sexual transition from female to male occurred prior to maturation. No annual spawning periods were identified, but the ubiquitous presence of post-ovulatory follicles in females and spermatogenic material in males coupled with a consistent lunar trend in gonadosomatic index patterns suggests the species spawns every lunar cycle throughout the year with spawning activity potentially increasing around the new moon. Ratios of natural to fishing mortality indicate a moderate level of exploitation (0.37); however, a large portion of harvested females had not reached reproductive maturity, suggesting that formal assessments of stock status are warranted to ensure the sustainable harvest of the species in CNMI.

Publication date: February 7, 2017

Available online: <http://link.springer.com/article/10.1007/s10228-017-0573-8>



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

A review of molecular genetic markers and analytical approaches that have been used for delimiting marine mammal subspecies and species

Marine Mammal Science (1.665)

P. E. Rosel (NMFS/SEFSC), B. L. Taylor (NMFS/SWFSC), B. L. Hancock-Hanser (NMFS/SWFSC), P. A. Morin (NMFS/SWFSC), F. I. Archer (NMFS/SWFSC), A. R. Lang (NMFS/SWFSC), S. L. Mesnick (NMFS/SWFSC), V. L. Pease (NMFS/SWFSC), W. F. Perrin (NMFS/SWFSC), K. M. Robertson (NMFS/SWFSC), M. S. Leslie (NMFS/SWFSC), A. Berta, F. Cipriano, K. M. Parsons (NMFS/AKFSC), A. Viricel (NMFS/SEFSC), N. L. Vollmer (NMFS/OST), K. K. Martien (NMFS/SWFSC)

- A review of the literature indicates mitochondrial DNA data are commonly used to delimit cetacean subspecies and species and do a fairly good job.
- While the mitochondrial DNA control region is the primary genetic marker used to delimit cetacean species and subspecies, analytical methods vary greatly across studies.
- Examining the published literature revealed a mixture of sound and inadequate practices for genetic studies of cetacean taxonomy, suggesting that improvements could be made to the field by developing standard guidelines.

Uncertainty in marine mammal taxonomy is increasingly being addressed using molecular genetic data. We examined 32 peer-reviewed articles published between 1994 and 2011 to review methodological practices, consistency of markers and analytical methods, and overall quality of arguments used when genetic data have been employed to delimit new species and subspecies of marine mammals. The mitochondrial DNA (mtDNA) control region was the primary genetic marker used in these studies, but analytical methods varied greatly across studies.

Diagnosability, a common metric for delimiting subspecies with morphological data, was only used through citing of fixed differences in mtDNA sequences. Assignment tests based on microsatellite data were less common but were applied at both taxonomic levels. Nuclear DNA sequence data were rarely used. Basic background material needed to evaluate the strength of arguments, such as distribution and sampling maps, were often missing. For most studies, sample sizes were good, but adequate geographic sampling for broadly distributed taxa was often lacking, diminishing the strength of evidence for taxonomic distinctness. Examining these empirical cases revealed a mixture of sound and



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inadequate practices for genetic studies of cetacean taxonomy and suggested that improvements could be made to the field by developing standard guidelines.

Acceptance date: January 3, 2017

OAR Publications

Improving volcanic ash predictions with the HYSPLIT dispersion model by assimilating MODIS satellite retrievals

Atmospheric Chemistry and Physics (5.114)

T. Chai, A. Crawford, B. Stunder, M. Pavolonis, R. Draxler, and A. Stein (OAR/ARL)

- Optimal volcanic ash plume source terms can be estimated using the HYSPLIT dispersion model and satellite observations of ash mass loadings and ash cloud top height.

Currently NOAA's National Weather Service (NWS) runs the HYSPLIT dispersion model with a unit mass release rate to predict the transport and dispersion of volcanic ash. The model predictions provide information for the Volcanic Ash Advisory Centers (VAAC) to issue advisories to meteorological watch offices, area control centers, flight information centers, and others. This research aims to provide quantitative forecasts of ash distributions generated by objectively and optimally estimating the volcanic ash source strengths, vertical distribution and temporal variations using an observation-modeling inversion technique. In this top-down approach, a cost functional is defined to mainly quantify the differences between model predictions and the satellite measurements of column integrated ash concentrations, weighted by the model and observation uncertainties.

Minimizing this cost functional by adjusting the sources provides the volcanic ash emission estimates. As an example, MODIS (MODerate Resolution Imaging Spectroradiometer) satellite retrievals of the 2008 Kasatochi volcanic ash clouds are used to test the HYSPLIT volcanic ash inverse system. Because the satellite retrievals include the ash cloud top height but not the bottom height, there are different model diagnostic choices when comparing the model results with the observed mass loadings. Three options are presented and tested. Although the emission estimates vary significantly with different options the subsequent model predictions with the different release estimates all show decent skill when evaluated against the unassimilated satellite observations at later times. Among the three options, integrating over three model layers yields slightly better results than integrating from the surface up to the observed volcanic ash cloud top or using a single model layer. Inverse tests also show that including the ash-free region to



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constrain the model is not beneficial for the current case. In addition, extra constraints to the source terms can be given by explicitly enforcing "no-ash" for the atmosphere columns above or below the observed ash cloud top height. However, in this case such extra constraints are not helpful for the inverse modeling. It is also found that simultaneously assimilating observations at different times produces better hindcasts than only assimilating the most recent observations.

Publication Date: February 24, 2017

Available online: <http://www.atmos-chem-phys.net/17/2865/2017/acp-17-2865-2017.pdf>

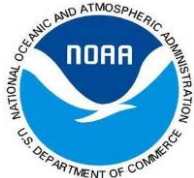
Multiple metabolisms constrain the anaerobic nitrite budget in the Eastern Tropical South Pacific

Global Biogeochemical Cycles (4.495)

A. R. Babbin, B. D. Peters, **C. W. Mordy (OAR/PMEL)**, B. Widner, K. L. Casciotti, and B. B. Ward.

- This study directly measured *in situ* anaerobic rates produce the broad dissolved nitrogen profiles in oxygen deficient zones, assuming contributions from both anammox and denitrification.
- Nitrite and nitrate are rapidly cycled in oxygen deficient zones, and iodate stimulates significant rates of nitrite oxidation in the upper oxygen deficient zone.
- Cyanate can act as a reduced nitrogen source for anammox, while urea is not directly used.

The Eastern Tropical South Pacific is one of the three major oxygen deficient zones (ODZs) in the global ocean, and is responsible for approximately one-third of marine water column nitrogen loss. It is the best studied of the ODZs, and like the others, features a broad nitrite maximum across the low oxygen layer. How the microbial processes that produce and consume nitrite in anoxic waters interact to sustain this feature is unknown. Here, we used ^{15}N -tracer experiments to disentangle five of the biologically-mediated processes that control the nitrite pool, including a high-resolution profile of nitrogen loss rates. Nitrate reduction to nitrite likely depended on organic matter fluxes, but the organic matter did not drive detectable rates of denitrification to N_2 . However, multiple lines of evidence show that denitrification is important in shaping the biogeochemistry of this ODZ. Significant rates of anaerobic nitrite oxidation at the ODZ boundaries were also measured. Iodate was a potential oxidant that could support part of this nitrite



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consumption pathway. We additionally observed N₂ production from labeled cyanate and postulate that anammox bacteria have the ability to harness cyanate as another form of reduced nitrogen rather than relying solely on ammonification of complex organic matter. The balance of the five anaerobic rates measured – anammox, denitrification, nitrate reduction, nitrite oxidation, and dissimilatory nitrite reduction to ammonium – are sufficient to reproduce broadly the observed nitrite and nitrate profiles in a simple one-dimensional model, but require an additional cryptic source of reduced nitrogen to the deeper ODZ to avoid ammonium overconsumption.

Publication date: February 4, 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/2016GB005407/full>

Widespread tectonic extension at the Central Indian Ridge between 8°S and 18°S
Gondwana Research (8.743)

S.-J. Pak, J.-W. Moon, J. Kim, M. T. Chandler, H.-S. Kim, J. Son, S.-K. Son, S. K. Choi, and **E. T. Baker (OAR/PMEL)**

- The authors report the first high-resolution mapping survey over the middle part of Central Indian Ridge, which identified 11 prominent ocean core complexes and 4 non-transform discontinuities in the area.
- Morphotectonic features indicate the middle part of the Central Indian Ridge was developed mainly via tectonic extension.
- The ocean core complexes and non-transform discontinuities are spatially related to seafloor hydrothermal activity.

The middle part of the Central Indian Ridge (MCIR) between 8°S and 18°S is representative of mid-ocean ridges in the Indian Ocean but has not previously been systematically surveyed. Here we present results from the first high-resolution mapping survey over both on- and off-axis sections of the MCIR including multibeam bathymetry, magnetics, hydrocasting, and seabed sampling. The 700-km-long MCIR consists of six first-order segments that are offset by > 30 km along well-developed transform faults. Three of the first-order segments are further divided into seven second-order segments with < 30 km offset along non-transform discontinuities. We have recognized for the first time 11 prominent ocean core complexes (OCCs). These occur at nearly all segment ends, corresponding to an occurrence every 60 km of the surveyed ridge. Seafloor spreading model studies using magnetic reversals show that the MCIR is a slow-spreading ridge with average full opening rates ranging from 33.7 to 45.1 mm/yr, increasing from north to south. The highly curved and intermittent axial ridge geometry, rugged flank



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fabric, variation in the depth and width of the middle valley, and the frequent occurrences of ocean core complexes and non-transform discontinuities demonstrate that asymmetric accretionary processes are dominant along the ridge. The spreading rate symmetry combined with morphotectonic features, reveal that the MCIR segments developed mainly via tectonic extension with little magmatism. Segments with asymmetric accretion controlled by tectonic extension makes up ~ 96% of the MCIR, whereas symmetric accretion controlled by robust magmatism make up < 4%. Hydrothermal plumes with high methane concentrations occur frequently over the OCCs. This finding indicates that abundant OCCs exposed by detachment faults lead to extensive hydrothermal circulation at off-axis areas and that detachment faults are the primary fluid path for hydrothermal fluid circulation at off-axis regions. Serpentinization of mantle-derived rock at OCCs may be one of the major sources of heat and methane in off-axis areas.

Publication date: January 27, 2017

Available online:

<http://www.sciencedirect.com/science/article/pii/S1342937X17300588>

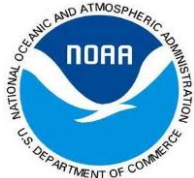
Two decades of Pacific anthropogenic carbon storage and ocean acidification along GO-SHIP Sections P16 and P02

Global Biogeochemical Cycles (4.495)

B. R. Carter, R. A. Feely, S. Mecking, J. N. Cross, A. M. Macdonald, S. A. Siedlecki, L. D. Talley, C. L. Sabine (OAR/PMEL), F. J. Millero, J. H. Swift, A. G. Dickson, and K. B. Rodgers

- Pacific Canth increased by 6.1 ± 1.5 PgC between 1990s and 2000s and by 8.8 ± 2.2 PgC between the 2000s and 2010s.
- Novel ensemble extended multiple linear regression can resolve and reduce uncertainties from regression coefficient choices.
- Anthropogenic carbon uptake increased in the Southern Pacific in the recent decade, likely due to enhanced Pacific Subtropical Cell ventilation.

A modified version of the extended multiple linear regression (eMLR) method is used to estimate anthropogenic carbon concentration (Canth) changes along the Pacific P02 and P16 hydrographic sections over the past two decades. P02 is a zonal section crossing the North Pacific at 30°N and P16 is a meridional section crossing the North and South Pacific at ~150°W. The eMLR modifications allow the uncertainties associated with choices of regression parameters to be both resolved and reduced. Canth is found to have increased throughout the water



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

column from the surface to ~1000 m depth along both lines in both decades. Mean column Canth inventory increased consistently during the earlier (1990s-2000s) and recent (2000s-2010s) decades along P02, at rates of 0.53 ± 0.11 and 0.46 ± 0.11 mol C m⁻² a⁻¹, respectively. By contrast, Canth storage accelerated from 0.29 ± 0.10 to 0.45 ± 0.11 mol C m⁻² a⁻¹ along P16. Shifts in water mass distributions are ruled out as a potential cause of this increase, which is instead attributed to recent increases in the ventilation of the South Pacific Subtropical Cell. Decadal changes along P16 are extrapolated across the gyre to estimate a Pacific Basin average storage between 60°S and 60°N of 6.1 ± 1.5 PgC decade⁻¹ in the earlier decade and 8.8 ± 2.2 PgC decade⁻¹ in the recent decade. This storage estimate is large despite the shallow Pacific Canth penetration due to the large volume of the Pacific Ocean. By 2014, Canth storage had changed Pacific surface seawater pH by -0.08 to -0.14 and aragonite saturation state by -0.57 to -0.82.

Publication date: February 10, 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/2016GB005485/full>

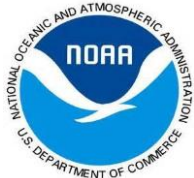
Barrier effect of the Indo-Pacific Maritime Continent on the MJO: Perspectives from tracking MJO precipitation

Journal of Climate (4.31)

C. Zhang (OAR/PMEL) and J. Ling

- This paper explores explanations on how the Indo-Pacific Maritime Continent affects the Madden-Julian Oscillation.

Explanations for the barrier effect of the Indo-Pacific Maritime Continent (MC) on the MJO should satisfy two criteria. First, they should include specific features of the MC, namely, its intricate land-sea distributions and elevated terrains. Second, they should include mechanisms for both the barrier effect and its overcoming by some MJO events. Guided by these two criteria, we applied a precipitation-tracking method to identify MJO events that propagate across the MC (MJO-C) and those that are blocked by the MC (MJO-B). About a half of MJO events that form over the Indian Ocean propagate through the MC. Most of them (> 75%) become weakened over the MC. The barrier effect cannot be explained in terms of the strength, horizontal scale, or spatial distribution of MJO convection when it approaches the MC from the west. A distinction between MJO-B and MJO-C is their precipitation over the sea vs. land in the MC region. MJO-C events rain more over the sea than over land, whereas land rainfall dominates for MJO-B. This suggests that inhibiting convective development over the sea could be a possible mechanism for the barrier effect of the MC. Preceding conditions for MJO-C



NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 13, 2017

include stronger low-level zonal moisture flux convergence and higher SST in the MC region. Possible connections between these large-scale conditions and the land vs. sea distributions of MJO rainfall through the diurnal cycle are discussed.

Publication date: January 20, 2017

Available online: <http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-16-0614.1>

A decade of volcanic construction and destruction at the summit of NW-Rota-1 Seamount, 2004–2014

Journal of Geophysical Research (3.44)

S. R. Schnur, **W. W. Chadwick Jr.**, **R. Embley**, V. Ferrini, C. de Ronde, K. Cashman, N. Deardorff, **S. G. Merle**, **R. Dziak**, **J. Haxel**, and **H. Matsumoto** (OAR/PMEL)

- Repeat bathymetric mapping, remotely operated vehicle observations and hydrophone records document changes in geology and eruptive style at Northwest Rota- 1 Seamount.
- Changes in eruptive activity between 2009 and 2010 impacted the type and distribution of geologic lithofacies at the summit of Northwest Rota- 1.
- Landslides are important agents of change at submarine arc volcanoes and their frequency is controlled by cyclic eruptive activity.

Arc volcanoes are important to our understanding of submarine volcanism because at some sites frequent eruptions cause them to grow and collapse on human timescales. This makes it possible to document volcanic processes. Active submarine eruptions have been observed at the summit of NW Rota-1 in the Mariana Arc. We use ROV videography and repeat high-resolution bathymetric surveys to construct geologic maps of the summit of NW Rota-1 in 2009 and 2010, and relate them to the geologic evolution of the summit area over a ten-year period (2004-2014). We find that 2009 and 2010 were characterized by different eruptive styles, which affected the type and distribution of eruptive deposits at the summit. 2009 was characterized by ultra-slow extrusion and auto-brecciation of lava at a single eruptive vent, producing a large cone of blocky lava debris. In 2010, higher energy explosive eruptions occurred at multiple closely-spaced vents, producing a thin blanket of pebble-sized tephra overlying lava flow outcrops. A landslide that occurred between 2009 and 2010 had a major effect on lithofacies distribution by removing the debris cone and other unconsolidated deposits, revealing steep massive flow cliffs. This relatively rapid alternation between construction and destruction forms one end of a seamount growth and mass-wasting spectrum. Intra-plate seamounts, which tend to grow larger than arc volcanoes, experience collapse



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

events that are orders of magnitude larger and much less frequent than those occurring at subduction zone settings. Our results highlight the interrelated cyclicity of eruptive activity and mass wasting at submarine arc volcanoes.

Publication date: March 1, 2017

Available online:

<http://onlinelibrary.wiley.com/doi/10.1002/2016JB013742/abstract>

Quantifying the predatory effect of round goby on Saginaw Bay dreissenids

Journal of Great Lakes Research (1.910)

C. J. Foley, S. R. Andree, **S. A. Pothoven (OAR/GLERL)**, T. F. Nalepa, T. O. Hook

- Overall, results from this research suggest that it is unlikely that goby predation has had a large impact on dreissenid mussels in Saginaw Bay.
- Because predation is focused on the smallest mussels, goby could help suppress dreissenid populations in years to come.

Invasive dreissenid mussels (*D. polymorpha* and *D. r. bugensis*) have fundamentally altered Laurentian Great Lake ecosystems, however in many areas their abundances have declined since the mid-1990s. Another invader, the benthic fish round goby (*Neogobius melanostomus*), is morphologically adapted to feed on dreissenids and likely affects dreissenid populations; however, the degree of this predatory effect is variable. In 2009 and 2010, we examined round goby abundances, size distributions, diet contents, and diet selectivity in Saginaw Bay, Lake Huron; a shallow bay that has been subjected to numerous anthropogenic stressors. We further used a consumption model to estimate dreissenid consumption by three different size classes of round goby. Round gobies were found throughout the bay and most were smaller than 80 mm total length. Round gobies of all sizes consumed dreissenids (including fish as small as 30 mm total length), though dreissenids were rarely preferred. The relative proportion of dreissenids (by biomass) present in diets of round gobies increased with fish size, but also throughout the year for all size classes. Despite this, overall consumptive effects of round gobies on dreissenids in Saginaw Bay were low. Many dreissenids present in the bay were larger than those consumed by round gobies.

Bioenergetics-based model estimates suggest that the smallest round gobies are responsible for the majority of dreissenid consumption. While our findings are limited to soft substrates and influenced by sampling restrictions, our study design allowed us to put bounds on our estimates based upon these multiple sources of uncertainty.



NOAA SCIENTIFIC PUBLICATIONS REPORT
MARCH 13, 2017

Publication date: February 2017

Available online:

<http://www.sciencedirect.com/science/article/pii/S0380133016302039>

Moving from ecosystem-based policy objectives to operational implementation of ecosystem-based management measures

ICES Journal of Marine Science (2.626)

R. Cormier, **C. R. Kelble (OAR/AOML)**, M. R. Anderson, J. I. Allen, A. Grehan, and O. Gregersen

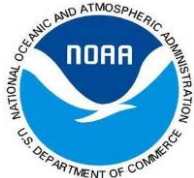
- Political scientists and ecologists from North America and Europe wrote the manuscript to highlight one of the key hurdles to implementing ecosystem-based management for coastal and marine ecosystems on both continents.
- The authors note that there are numerous planning initiatives for coastal and marine ecosystem-based management on both continents, but these plans never result in management measures/actions to implement them largely because the authority to implement management actions lies within individual sectors/agencies with their own goals and objectives.

The aim of ecosystem-based management (EBM) is to maintain an ecosystem in a healthy, productive and resilient condition through the implementation of policies and management measures. Although cross-sectoral planning may be led by a planning competent authority, it is up to the sector competent authority to implement the necessary management measures within their operations to achieve EBM goals and objectives. We suggest that scientific impediments to EBM are no longer significant to implement EBM operationally. Instead, we consider that approaching EBM within current policy cycle approaches would provide the necessary policymaking process step to operationalize EBM. In addition to enabling and facilitating collaboration, exchange, understanding as promoted by EBM, policymaking processes also require that policy is to be implemented through programs, measures, procedures and controls that have expected outcomes to “carry into effect” the policy objective. We are of the view that moving EBM from planning and objective setting to operational implementation is a management problem solving issues instead of a scientific one.

Publication date: October 25, 2016

Available online:

<https://academic.oup.com/icesjms/article/74/1/406/2444580/Moving-from-ecosystem-based-policy-objectives-to>



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

NESDIS Publications

Validation of the effect of cross-calibrated GOES solar proton effective energies on derived integral fluxes by comparison with STEREO observations

Space Weather (2.846)

J. V. Rodriguez (NESDIS/NCEI), I. Sandberg, R. A. Mewaldt, I. A. Daglis, and P. Jiggins

- This study validates the accuracy of current Space Weather Prediction Center Solar Radiation Storm Scale alerts at >10 MeV but questions accuracy of the associated alerts at >100 MeV.
- The results demonstrate good consistency between the two long-term solar proton data sets.

The derivation of integral fluxes from instrument coincidence rates requires accurate knowledge of their effective energies. Recent cross calibrations of GOES with the high-energy-resolution Interplanetary Monitoring Platform (IMP) 8 Goddard Medium Energy Experiment (GME) (Sandberg et al., Geophys. Res. Lett., 41, 4435, 2014a) gave significantly lower effective energies than those currently used by the NOAA Space Weather Prediction Center to calculate solar proton integral fluxes from GOES rates. This implies systematically lower integral fluxes than currently produced. This paper quantifies the differences between the current and the cross-calibrated GOES integral fluxes and validates the latter. Care is taken to rule out the spectral resolution of the measurements or different integration algorithms as major contributors to differences in the magnitudes of the derived integral fluxes. The lower effective energies are validated by comparison with the independent, high-resolution observations by the STEREO Low-Energy Telescope (LET) and High-Energy Telescope (HET) during the December 2006 solar proton events. The current GOES product is similar to the >10 MeV integral fluxes recalculated by using the Sandberg et al. [2014a] effective energies but is substantially greater at higher energies. (The median ratios of the current to the recalculated fluxes are 1.1 at >10 MeV, 1.7 at >30 MeV, 2.1 at >60 MeV, and 2.9 at >100 MeV.) By virtue of this validation, the cross-calibrated GOES integral fluxes should be considered more accurate than the current NOAA product. The results of this study also demonstrate good consistency between the two long-term IMP 8 GME and STEREO LET and HET solar proton data sets.

Publication date: February 2, 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/2016SW001533/full>



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

NWS Publications

On the impact and future benefits of AMDAR observations in operational forecasting - Part 2: Water vapor observations

Bulletin of the American Meteorological Society (7.929)

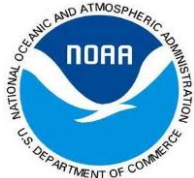
R. A. Petersen, L. Cnonce, **R. Mamrosh** (NWS/CR), R. Baker, P. Pauley

- Commercial aircrafts equipped with Water Vapor Sensing Systems are able to provide accurate observations of moisture.
- These observations increase the observed spatial and temporal moisture variability enhancing weather forecasts.

Although wind and temperature observations from commercial aircraft have been shown to improve operational numerical weather prediction (NWP) on global and regional scales, the quality and potential importance of newly available moisture observations are less well recognized. Because moisture changes often occur at much smaller scales than wind and temperature variations, these temporally and spatially frequent moisture observations can have exceptionally large impacts on forecasts of disruptive weather events and could help offset the dwindling number of global moisture observations. Currently, more than 148 aircraft-based Water Vapor Sensing Systems (WVSS; 139 operating in the US and 9 in Europe) provide specific humidity observations en route and in 1200 profiles made daily during takeoff/landing. Results of a series of assessments comparing data from initial WVSS sensors installed on 25 United Parcel Service (UPS) Boeing 757 aircraft with colocated raobs show agreement to within 0.5 g kg^{-1} , with minimal biases. Intercomparisons of observations made among nearby aircraft agree to better than 0.2 g kg^{-1} . The combined results suggest that the WVSS measurements are at least as accurate as water vapor observations from high-quality raobs. Information regarding observed spatial and temporal moisture variability could be important in optimizing the use of these observations in future mesoscale assimilation systems. Forecasts of disruptive weather events made by NWS and airline forecasters demonstrate the benefits obtained from combined temperature/moisture/wind profiles acquired during aircraft ascents and descents. Finally, initial NWP impact studies show that WVSS reports that include moisture obtained throughout the day have greater influence than twice-daily raob humidity data on contiguous U.S. (CONUS) forecasts for 24 h and beyond.

Publication date: December 20, 2016

Available online: <http://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-14-00211.1>



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

NOS Publications

An Economic Analysis of Shipping Costs and Pollution Emissions Related to Potential Measures to Manage the Co-Occurrence of Maritime Vessel Traffic and Whales in the Channel Islands Region

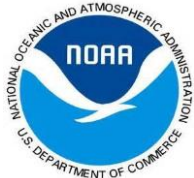
NCCOS Technical Memorandum

S. Ball Gonyo, T. L. Goedeke, K. E. Wolfe, C. F. G. Jeffrey, M. Gorstein, M. Poti, and D. S. Dorfman (NOS/NCCOS)

- The total costs to the Los Angeles/Long Beach (LA/LB) Port District shipping industry are predicted to decrease under the potential management measures with vessel re-routing and increase under the seasonal vessel speed reduction only measures, but none of these changes are significant and represent less than 1% of total vessel operating costs.
- Pollution emissions for NO_x, CO, and CO₂ and damages to whales are predicted to decrease under each potential management measure and these decreases are significant under each measure with a seasonal vessel speed reduction program.
- The estimated changes in pollution emissions represent a 1.2% to 8.5% change in NO_x emissions and a 0.7% to 4.0% change in CO emissions from the commercial marine vessel sector in the LA-Ventura-Santa Barbara County region and a 0.4% to 2.4% change in global CO₂ emissions from the shipping industry.

The objective of this report is to assess for Channel Islands National Marine Sanctuary (CINMS) and other agencies the economic effects of five potential management measures through a shipping cost and pollution emissions analysis. The total costs to the LA/LB Port Complex shipping industry are not predicted to change significantly under any of the potential management measures.

Additionally, the changes only represent a 0.1% to 0.6% change in total vessel operating costs on a hypothetical Hong Kong to LA/LB Port District transit and 0.0002% to 0.0004% of LA/LB Port District's cargo value. Pollution emissions and damages for NO_x, CO, and CO₂ are predicted to significantly decrease under potential management measures with seasonal VSRs. However, the predicted changes in pollution emissions only represent a 1.2% to 8.5% change in NO_x emissions and a 0.7% to 4.0% change in CO emissions from the commercial marine vessel sector in the LA-Ventura-Santa Barbara County region and a 0.4% to 2.4% change in global CO₂ emissions from the shipping industry. These results will provide additional information for CINMS and other agencies to determine the



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

feasibility of the analyzed potential management measures. Additionally, this study provides a framework for similar work in other regions.

NMFS Publications

Animal Movement: Statistical Models for Telemetry Data

Book

M. Hooten, **D. Johnson**, **B. McClintock** (NMFS/AKFSC), and J. Morales

- This book synthesizes a vast and diverse set of literature on animal movement modeling.
- The authors reconcile mathematical styles from many studies in a unified, consistent set of statistical notation for animal telemetry data.
- Detail is provided to understand and develop models for different approaches to biotelemetry analysis, including incorporation of uncertainty.

The study of animal movement has always been a key element in ecological science, because it is inherently linked to critical processes that scale from individuals to populations and communities to ecosystems. Rapid improvements in biotelemetry data collection and processing technology have given rise to a variety of statistical methods for characterizing animal movement. The book serves as a comprehensive reference for the types of statistical models used to study individual-based animal movement.

Animal Movement is an essential reference for wildlife biologists, quantitative ecologists, and statisticians who seek a deeper understanding of modern animal movement models. A wide variety of modeling approaches are reconciled in the book using a consistent notation. Models are organized into groups based on how they treat the underlying spatio-temporal process of movement. Connections among approaches are highlighted to allow the reader to form a broader view of animal movement analysis and its associations with traditional spatial and temporal statistical modeling.

After an initial overview examining the role that animal movement plays in ecology, a primer on spatial and temporal statistics provides a solid foundation for the remainder of the book. Each subsequent chapter outlines a fundamental type of statistical model utilized in the contemporary analysis of telemetry data for animal movement inference. Descriptions begin with basic traditional forms and sequentially build up to general classes of models in each category. Important background and technical details for each class of model are provided, including spatial point process models, discrete-time dynamic models, and continuous-time stochastic process models. The book also covers the essential elements for how to



NOAA SCIENTIFIC PUBLICATIONS REPORT MARCH 13, 2017

accommodate multiple sources of uncertainty, such as location error and latent behavior states. In addition to thorough descriptions of animal movement models, differences and connections are also emphasized to provide a broader perspective of approaches.

Publication date: January 26, 2017

*The use of satellite tags to inform the stock assessment of a data poor species:
Estimating vertical availability of spiny dogfish in the Gulf of Alaska*
Assessing and Managing Data-Limited Fish Stocks, Alaska Sea Grant

P. F. Hulson, C. A. Tribuzio (NMFS/AKFSC), and K. Coutre

- Vertical availability of spiny dogfish in the Gulf of Alaska to the bottom trawl survey was estimated for use in management.
- The study concluded that based on where spiny dogfish are found in the water column, population estimates are likely underestimated.

In Alaska, harvest specifications for many data-poor stocks are determined by using the product of estimated biomass from the Alaska Fisheries Science Center bottom trawl survey and a pre-specified fishing mortality rate. For Pacific spiny dogfish (*Squalus suckleyi*) in the Gulf of Alaska the bottom trawl survey biomass estimates are highly variable. In this study we used pop-up satellite archival tag data to estimate the vertical availability of spiny dogfish to the bottom trawl survey (the proportion of time spent under the headrope of the bottom trawl during survey operating hours) with the underlying goal of determining if the biomass estimates for this species from the bottom trawl survey can be improved. We estimated the vertical availability with two methods: one that assumed the bottom depth was the maximum depth recorded by the pop-up satellite tag in a 24 hour period, and the other that used the uncertainty in mean daily location estimates provided by a geolocation model to obtain bathymetric bottom depths around the mean daily location to compare with the depths recorded by the satellite pop-up tags. Using the satellite pop-up tag data we determined that the estimated vertical availability to the bottom trawl of spiny dogfish (that were either tagged or recovered in the Gulf of Alaska during the survey months) from the first method was 0.6, and from the second method was 0.03. Taken together, the availability of spiny dogfish to the bottom trawl survey in the GOA can be quite small which suggests that the biomass estimates from the bottom trawl survey are likely underestimated.

Publication date: November 1, 2016

Available online: <https://doi.org/10.4027/amdlfs.2016.06>